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The Vegetable Industry of Pennsylvania

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Celery being blanched with paper collars. Endive in foreground.

F. P. WILLITS, *Secretary of Agriculture.*

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PENNSYLVANIA DEPARTMENT OF AGRICULTURE.

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FRANK P. WILLITS, *Secretary* JOHN M. McKEE, *Deputy Secretary.*

This Department is essentially a service agency created by legislative enactment to deal with administrative, regulatory, investigational, and educational problems which can best be solved through public rather than individual action. The organization provides for coordination and cooperation with the Pennsylvania State College and the U. S. Department of Agriculture. The Department operates through the following bureaus:

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Licenses and regulates egg-opening plants and cold storage warehouses, maintaining regular inspection and enforcing twelve-month storage limit;

Inspects milk plants and creameries and regulates weighing, testing, buying and selling of milk and cream on a butterfat basis;

Protects honest manufacturers, importers, selling agents and ultimate users of feeding stuffs, fertilizers, lime products, linseed oil, paint, putty, turpentine, insecticides and fungicides, by means of annual registrations followed by inspections, analyses, prosecutions and the publication of the analyses of these products;

Analyses special samples for residents of the State at the rate of $1.00 a sample for feeding stuffs, lime products and linseed oils.

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Investigates and assists in the marketing of farm products; at present chiefly grain and hay, fruits and vegetables, poultry and eggs, and tobacco;

Compiles and distributes daily market information as to supplies, shipments and prices;

Advises growers on transportation of agricultural products;

Assists cooperative associations and public markets;

Establishes standard grades of farm products and maintains inspection;

STATISTICS: L. H. WIBLE, *Director.*

Assembles and disseminates essential statistics and facts pertaining to the agriculture of the State, from monthly reports rendered by hundreds of volunteer crop correspondents, information which assists the producer in his sales and interests all industries which deal with agricultural products;

Cooperates with U. S. Bureau of Agricultural Economics in joint crop and livestock reporting and publishes annual and monthly summaries of the data;

Compiles dates of county and local fairs and assembles data pertaining to their success and results during each year.

VEGETABLE INDUSTRY OF PENNSYLVANIA

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THE VEGETABLE INDUSTRY OF PENNSYLVANIA

By C. R. MASON[1]

Pennsylvania State College

FOREWORD

The first detailed survey of Pennsylvania vegetable growing was made from 1920 to 1924, the Pennsyvlania Department of Agriculture and the Pennsylvania State College cooperating.

The purpose of this survey was to find:

1. Where the vegetables consumed in Pennsylvania are grown.
2. In what sections of the State and by whom are vegetables grown.
3. The present condition of the vegetable industry.
4. Ways in which the vegetable grower may improve his products and increase his returns.
5. Opportunities for the expansion of vegetable growing in Pennsylvania.

The data as assembled may be in some cases only approximate since it was practically impossible to secure personal interviews and definite information from the numerous small gardeners. Likewise many vegetable growers have not kept accurate records of costs and returns, fertilizers used, and other information that would be of value. Practices, too, change perhaps more rapidly in vegetable growing than in any other line of agriculture.

PENNSYLVANIA, A VEGETABLE GROWING STATE

There are in Pennsylvania a few highly developed market gardening and trucking centers which at certain seasons supply large amounts of produce. In all parts of the State the farm garden plays a great part in vegetable supply. The greenhouses provide a certain amount of green vegetables through the winter months. Today, people demand fresh vegetables throughout the year, so that in various parts of the State at certain seasons a large amount of vegetable produce is imported from other states.

Home Grown Vegetables Important

Home grown vegetables are produced in every county in the State, both in private gardens and more or less on general farms. The

[1]This bulletin is the third and last of a series on the vegetable industry of Pennsylvania. This series has been made possible through the cooperation of vegetable growers and members of the staffs of the Pennsylvania State College and the Pennsylvania Department of Agriculture. Special mention is due Professor W. C. Pelton, formerly of the State College staff, for assembling much of the data in the general section of the bulletin; W. B. Nissley for suggestions and criticisms; and Norman S. Grubbs of the Portland Cement Association, for material and notes on storage.

production from the farm vegetable gardens is perhaps greatest in the southeastern counties because the average of the soils is better there and the cities are more accessible to a wide expanse of territory. In such counties as Adams, Berks, Bucks, Chester, Cumberland, Dauphin, Franklin, Lancaster, Lebanon, Lehigh, Montgomery and York, farm trucking is common near all the cities and larger towns. The products of such gardens cut less figure in the other counties though they are still a factor, especially in sections where there are few strictly commercial vegetable growers. In the two tiers of counties just south of the New York line, and in western Pennsylvania, as well as sections near Philadelphia and Pittsburgh, a surprisingly large amount of vegetables is brought in from other states. Much of this produce could doubtless be grown in Pennsylvania.

SOILS INFLUENCE VEGETABLE GROWING

Soils for vegetable production must be more carefully chosen than for many other farm crops. They must first of all contain a large amount of plant food since vegetables are heavy feeders. Vegetables depend for their quality largely on a constant water supply; therefore the power of the soil to absorb or hold water is of deep concern. Poorly drained soils may not be used since vegetable crops need a certain amount of aeration for best growth. As constant cultivation is essential, a light soil is most desirable. Level soils are better than steep slopes because of easier working and less washing. Freedom from stones is of importance when growing some crops. Many soils otherwise desirable for vegetables may be inaccessible to good roads or too far removed from markets.

As a whole there is considerable difference in the soil demands of the market gardener and the trucker. The former generally selects a location near a satisfactory market, uses only a comparatively small amount of land for which he is willing to pay a high price, may use irrigation as crop insurance, and improves his soil through the use of heavy manure and fertilizer applications; finally modifying its physical structure so that little trace of the original soil remains. All this in order that he may market directly to retailers, consumers, and occasionally wholesalers, nearby.

The trucker on the other hand is further removed from market and sells largely on a wholesale basis. He depends to a great extent on the natural fertility of the soil together with whatever improvement he can make through crop rotation and the turning of green crops. He is therefore more particular in picking a soil adapted to his crops, for since generally a shipper, distance from market does not mean so much as to the market gardener. These points regarding soils for trucking and market gardening must be borne in mind when considering the data which follows.

Pennsylvania Has Variety of Soils

Pennsylvania is marked by extreme variation in soils. Along the Atlantic Coastal plain are found sandy types of the sort used in New Jersey for vegetable growing although these types are now largely covered by city buildings.

There is a mountainous area having much rough land but also limestone valleys of great fertility; and a plateau region in which the soils are derived largely from shale and sandstone. Several extensive areas in northwestern and northeastern Pennsylvania embrace whole counties in which glaciers brought soil material from the north and scooped out lakes that later were drained and now form our muck lands. Along Lake Erie is a narrow band of sand and gravel laid down ages ago by a more extensive lake There are many useful stream bottom soils. All these types taken together offer a wide selection to the prospective vegetable gardener and a satisfactory soil for almost any crop.

Philadelphia District Ranks High

Perhaps the best known vegetable section in the State is that around Philadelphia, the northeast section including Bustleton, Frankford, Tacony, Somerton, Fox Chase, and Torresdale and extending into Bucks County; the Meadow land to the south comprising South Broad Street, Island Road, Magazine Lane, and Powers Lane, this same sort of land extending into Delaware County and used for vegetable growing there. Both these sections are gradually being absorbed by the city and market gardeners are looking toward locations further out where cheaper land will be available. Most of the market gardens in these sections are located on soils of clay loam nature though there are small patches of sandy loam that the city has not yet absorbed. Spinach, celery, carrots, asparagus, lettuce and cabbage are crops of particular importance among the market gardeners of this district, and sweet corn, beets, cabbage and carrots among the truckers.

On sandy soil of lower Bucks County known as the Penns' Manor section asparagus production reaches its highest development in the State. From here are shipped many truckloads of fancy "grass" each year to "top" the New York market. Other truck of all kinds including celery, tomatoes, carrots, onions, and okra are also raised in this part of Bucks County.

Pittsburgh District Distribution Center

According to the 1920 census Allegheny County has a greater area devoted to vegetable production than any other county in the state, with over seven thousand acres planted in vegetables. To the north,

northeast, and northwest of Pittsburgh many thriving market gardens are operated for the supply of the city market. No home grown vegetables are shipped out of this section though Pittsburgh is considered a distributing point for a host of smaller Pennsylvania cities.

Much of the gardening in this district is done on Westmoreland soils. These owe their origin to the breaking down of interbedded sandstone, shale and some limestone, and are not the most desirable type for vegetable production since they are not particularly fertile. River bottom soils are also used in the Pittsburgh section. Neville's' Island in the Ohio has been known a long time as a productive gardening center, but is now being taken over for industrial development. As a whole, the excellence of the markets in Pittsburgh and surrounding cities rather than good soil has made this district important in vegetable production.

Erie Has Favorable Soil and Climate

The Erie section is of considerable importance from the vegetable growers' standpoint, due to soil and climatic conditions as well as to proximity of markets and transportation facilities. The sandy or gravelly, well drained soils bordering the lake, and belonging to the Dunkirk series, seem especially adapted to asparagus, which is widely planted around Northeast; tomatoes for the canning factory; and other vegetables, little of which, except the two crops mentioned, is shipped away from local markets.

River Bottom Soils of Great Value

River bottom and stream bottom soils of marked value for vegetable growing occur in many parts of the State. Such soils are usually of proper texture for early crops, and sometimes are enriched by the organic matter carried to them by the water. Along the larger rivers they are likely to be conveniently located since the railroads and improved highways commonly follow the river valleys and the factory towns and cities follow the railroads. However, some stream bottom soils are subject to damage from overflow, or are wet in the spring when earliest crops should be planted. In other cases the bottom lands are poorly drained at all seasons and tile drainage may be impossible without dredging because of the shallowness of the stream bed; the land may be too stony for efficient cultivation; or it may be so cut up by old or deviating stream channels that cultivation would be uneconomical. While there are narrow bands of stream-made soils along all the larger streams, the Susquehanna River with its tributaries has done the most work in soil making.

Wilkes-Barre Vegetable Section

The greatest development of stream-made soils is found near Williamsport, at Montandon north of Sunbury, at Wilkes-Barre, and in the vicinity of Altoona and Hollidaysburg. The Williamsport market is supplied to a large extent with fresh vegetables grown in the productive garden farms on the sandy soils at the edge of the city. At Montandon such vegetables as lima beans, muskmelons, watermelons, and sweet potatoes are grown extensively. The sandy soil here is rather coarse, very deep, and well elevated above the river, but is reported to hold moisture well through the summer. Below Sunbury there are several islands in the Susquehanna River and some sandy soil at McKee's Half Falls where excellent melons are grown.

Of the more intensively operated garden sections, Wilkes-Barre with its excellent river bottom land is among the leaders. A great variety of green vegetables is grown here, and several greenhouses keep the season open during the winter. Very little produce grown here is available for shipment to other cities, as Greater Wilkes-Barre has a population of 350,000 with the central market at Wilkes-Barre and the amount of good land available is even now decreasing rapidly, owing to the expansion of the city over the level river bottom. Gardeners here will be compelled to take up less desirable farm land farther from the city. A large majority of the population is of recent European descent. These people are exceptionally heavy vegetable eaters, especially of "greens" crops and many of them are skilled gardeners.

Throughout the length of the Juniata river are occasional strips of alluvial soil, few of which, except to a small degree at Lewistown, and on an island at Huntingdon, are used for vegetables. At Lewistown there is probably more produce grown on the hills than on the river flats, since it happens that some of the hills have sandy soil on their summits or slopes while the bottom lands there are subject to overflow in the spring. It is an evident advantage to a man who wishes to grow general farm crops as well as vegetables to have only a small amount of sandy land with the rest of his farm on the more productive types of soil. This condition exists around Lewistown and explains to some degree the little use of river soils there for vegetable growing. At Huntingdon the Pennsylvania Industrial Reformatory operates 60 acres of land on an island in the Juniata River.

Much Sandy Soil Available

At the juncture of the Juniata with the Susquehanna at Duncannon are located two islands consisting entirely of river made soil. These are not used intensively at present for vegetable growing but they are well adapted and near enough Harrisburg to be reasonably sure of an outlet for the produce.

Near Petersburg and Alexandria are areas of stream-laid soils that are famous for their productivity. Markets are not at present near enough to justify their extensive use for vegetable growing but they provide a useful resource that may be needed in the future.

From Tyrone to Altoona there is an unbroken strip of bottom land, much of which could be used for vegetables. Some of it is trucked at present while other parts are too heavy for this purpose.

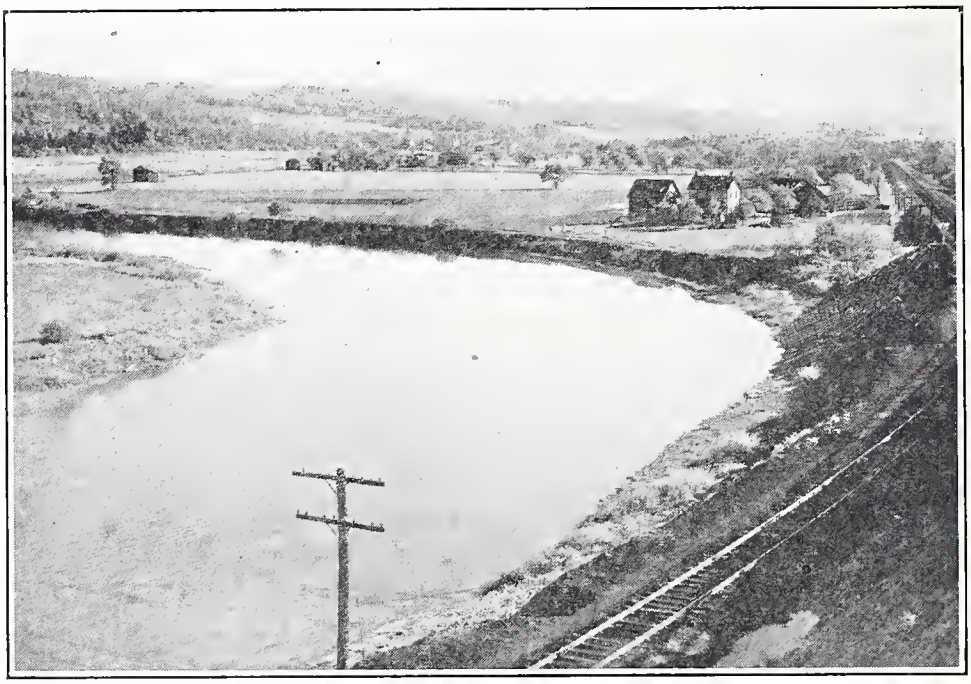


Fig. 1. Bottom land near Clearfield, Clearfield County, excellent for early vegetables.

There is considerable gardening in the light soils around Eldorado and Hollidaysburg along branches of the Juniata River.

At present the use of many of the lighter types of soils along the streams of central Pennsylvania is limited by the fact that the demand is restricted to early produce. In all these sections vegetables are grown by the general farmers, located on the more productive soils of the hills or limestone valleys with a supply of manure from farm animals that keeps their soils at a high pitch of productiveness. Such soils are better adapted to the growing of summer and fall vegetables than the sandy types unless the latter are irrigated.

Another class of sandy soils that might be of future interest is the Morrison series, the so-called Barren soils, found chiefly in Center, Huntingdon and Blair Counties. At present much of this area is little used even for general farming since the soils are usually porous, droughty, infertile, in need of lime, and often stony. Water is also hard to get and that hinders their development. Their value for melons has been demonstrated at Warriors' Mark in Northern Hunt-

ingdon County but obviously the "barrens" cannot be used profitably for vegetables as long as more productive soils of sandy nature are available, or until an extensive shipping trade in early vegetables can be developed.

Productive Muck Soils in Northern Counties

Pennsylvania has no such acreage of black muck soils as have some of the other states. Perhaps the largest single area, very little of which has yet been put into use, is the area known as the Pymatuning Swamp in Crawford County. Linesville, on the north end of this swamp, has been known for many years for its shipments of onions, while small amounts of cabbage and root crops are also grown. West of Erie along the lake shore there are narrow bands of black soil which formerly supported a thriving onion growing industry though now not of great importance. In Mercer County are small tracts of land along the streams which may some day be drained and put to use for market gardening.

In the northeastern counties of the State there are many areas of muck soil which need only drainage to make them highly productive. This is particularly true of Wayne, Pike, Monroe, and Luzerne Counties. In Bradford County there are about 100 acres of cleared and drained muck land at Snedeker, on part of which celery, onions, and potatoes are grown. In Tioga County west of Wellsboro some 300 acres or more of black soil is cultivated, not more than half of it in vegetables. Here celery is almost the only vegetable grown.

Pocono Section Offers Opportunity

The summer resort section embracing Monroe and Pike counties provides an excellent market for vegetables during three months of summer. The district is also increasing in popularity for winter sports, fishing and hunting so that demand for fresh foods is gradually extending through the fall and winter. At present a comparatively small proportion of the vegetables consumed in these counties is grown locally. Much is shipped in carlots from New York and more trucked by peddlers from Scranton and Philadelphia. One resort association alone expends nearly $100,000 annually for fruits and vegetables secured outside the county. Another imports a carload a week from New York. The smaller hotels and cottages are also poorly supplied from local sources. The members of several of the resort associations are not satisfied with the quality of the vegetables shipped in and are willing to pay a bonus for strictly fresh, high quality products. Good river bottom and creek bottom land as well as small patches of muck are available for trucking. A growers' association has been formed in Monroe County that should solve the problem of some of the summer people in securing a steady supply

of high grade vegetables, and from the grower's standpoint, it is expected will provide a certain market for the goods grown. The Pocono section probably offers as fine opportunity for vegetable production for the farmers now living there as any part of Pennsylvania.

Southeastern Trucking Section is Famous

The agricultural fame of those Pennsylvania counties that lie southeast of a line drawn through the north boundaries of Northampton, Lehigh, Berks, and Cumberland Counties is due partly to the extremely fertile soils, but especially to the fact that this part of the State was settled at an early date by several industrious and skillful classes of farmers whose energy and intelligence have built up a wonderful farming industry. These counties also have long enjoyed the best of markets for farm and vegetable produce, such cities as Allentown, Easton, Harrisburg, Reading, Lancaster, and York, as well as a host of smaller places. In this entire area, outside of Philadelphia and Delaware Counties, many of the vegetables are furnished by the general farmer from his large home garden or from an acre or so of some standard crop that he raises as a side issue.

The soils in many of the counties, though fertile, are somewhat heavy for extra early crops and more difficult to work than the sandy types. The most productive are those of the Hagerstown series derived from limestone, a large area of which is found in Lancaster County, and an almost continuous belt runs through Northampton, Lehigh, Perks, Lebanon, Dauphin, Cumberland, and Franklin Counties, making part of the famous Cumberland Valley. Chester, Manor, and Penn soils series are of interest to the vegetable grower, while types of Berks soils lying chiefly on the north side of the Cumberland Valley, shaly soils, well drained, are used in a small way in the more level areas for melons and sweet potatoes. Throughout this section in general, vegetable growing leans toward trucking rather than market gardening. Canning crops, as tomatoes, sweet corn, and peas, are commonly grown to supply the canneries in these counties and in Pittsburgh and the corn drying industry northwest of Lancaster.

Gardening In The Mountainous Sections

The central and much of the western parts of the State are either mountainous or hilly in character. This area contains several important soils series of which the most extensive, DeKalb, covers more than forty per cent of the land area of the State. These are derived from sandstones and shales and are often productive, though the average DeKalb soil does not rank high. The upland types are apt to be stony and a few are too sandy to hold moisture well; the

shortness of the season in the higher altitudes also limits their use for commercial vegetable growing.

The more accessible and level DeKalb soils incline toward the heavier types, and these are well suited to late cabbage or main crop

Fig. 2. Cold frame yard on a garden farm near Montoursville, Lycoming County.

vegetables of various sorts. One of the few cabbage centers in the State is located in northern Indiana and southern Jefferson Counties. North of Punxsutawney lies a valuable area of level DeKalb soil where much cabbage and other vegetable crops are grown. Formerly onions from seed were commonly grown here.

Southeast of Johnstown is a gardening section which caters to that city and small coal towns in the neighborhood. Much of the soft coal mining in the State is carried on under DeKalb soil. The significance of this lies in the fact that among the miners cabbage is a popular vegetable, and for cabbage, DeKalb is a popular soil. Every coal town has its local cabbage growers, in the hard coal regions as well as in the soft coal districts of western Pennsylvania.

Some Trucking In Glaciated Sections

In Northwestern and northeastern parts of the State the land was covered ages ago by glaciers which entirely changed the aspect of the surface. As a whole the Volusia soils, which are the most common in sections visited by the glaciers, have poor natural drainage and in the western sections the surface is inclined to be so level in places that tile drainage is difficult. Another characteristic of these sections, outside of the part influenced by Lake Erie, is the shortness of the growing season. Here and there may be found well drained strips which are warm and well adapted for general vegetable growing but almost none of them can be expected to yield early crops.

In Erie County the Volusia soils are being used successfully for late cabbage growing. Here these soils are silt loams with considerable water holding capacity and this condition suits the late cabbage crop. Moreover, there is plently of manure on all the farms that grow this crop and manure is regularly used in the cabbage rotation.

The area just described is devoted largely to dairy farming. Vegetable growing as a specialty is hard to maintain in a strictly dairy community since the dairy farmer can manure his vegetable crop heavily and at relatively smaller expense than the specialist who has to purchase the manure. Then, too, the farmers in many such sections visit the markets regularly with dairy products and sell enough odds and ends of vegetables from their gardens to discourage the commercial grower. In the western part of this glaciated area there are excellent markets that might justify vegetable growers in struggling with an unfriendly soil. In the east, however, there are fewer markets, and those within easy reach as Wilkes-Barre, are well supplied with vegetables grown on bottom lands where the cost of production is less. Through these districts are scattered areas of muck land, formerly lakes or ponds formed by the glaciers that have already been mentioned.

From the preceding comments it may be seen that Pennsylvania soils are diverse enough to supply any reasonable demand of the vegetable grower. The extent of the several groups of first class vegetable growing soils is sufficient to assure an abundance of home grown vegetables of nearly all kinds except during parts of the winter and early spring when the Pacific Coast and southern states will continue to supply our markets. So far as soil resources are concerned it is safe to say that in the essential vegetable products Pennsylvania can be entirely self-supporting.

INFLUENCE OF VARIABLE CLIMATE ON VEGETABLE GROWING

Since the vegetable grower's crops are more affected by the weather than those of the general farmer, the former has considerable interest in knowing the underlying causes of weather conditions and the means at his disposal to regulate or offset the effects of weather. Climate as here used is a general term covering temperature averages and changes, wind, rainfall, sunshine, prevalence of frosts, factors affecting the temperature of the soil, and so on.

Effect of Latitude. The first factor that greatly affects temperature is latitude. For every degree of latitude a difference of four days in the beginning of spring and fall may be looked for, with differences also during the summer in average temperature. In Pennsylvania, which state extends about 2 1/4 degrees from north to south, one would expect spring to begin about nine days earlier on

the southern border than on the New York line. This would be true if the land were entirely level and no other factors such as large bodies of water interfered. As a matter of fact, crops may be planted considerably earlier in the southern counties than in the north counties, and the difference is apt to be more than nine days.

Influence of Altitude. It is well known that farms on the hill tops are usually later in getting under way than those in the valleys. The difference in season in spring and fall amounts to about one day for each hundred feet of elevation. Measured in degrees of temperature, Somerset and York, both interior cities of about the same latitude, compare as follows:

	Elevation	Mean Temperature
Somerset	2280 feet	48.5 degrees
York	400 "	53.2 "

In Centre County there is said to be two weeks difference in the growing season between Snowshoe and Milesburg, though the straight line distance between these places is little over eleven miles. The greater altitude of Snowshoe is the chief cause of this difference, although the sweep of winds over the more elevated town also has some effect. In all parts of the State elevation is found to affect noticeably the growth of tender crops like tomatoes, and at the higher points such crops are either not grown at all or only the earliest varieties are planted.

Longitude. A slight difference in annual temperature has been found between points that differ only in longitude, or distance west of Greenwich, England. For every fifty degrees of longitude a difference of four days in the beginning of spring and fall is to be looked for. As Pennsylvania extends but little more than five and one-half degrees in longitude, the effect of this law on climate would be very small, amounting to but a fraction of a day in favor of an earlier spring in the western part of the State.

Prevailing Winds. The direction of the prevailing winds is in some neighborhoods a factor of importance. For the State as a whole the winds blow most often from the west. In certain localities however, easterly winds or frequent winds from the north bring generally lower temperatures, while elsewhere prevailing southerly breezes tend to raise the annual mean temperature. The direction of the wind, taken in connection with the mountain ridges, has an influence on the distribution of rainfall, the country to the windward side receiving greater precipitation.

Influence of Bodies of Water. It is only in a narrow band of country close to Lake Erie that Pennsylvania climate is influenced to any degree by the presence of a large body of water. Here the water

causes the neighborhood to enjoy a later spring and also a later fall than surrounding country that may be similar in all other respects. For the three years during which records were kept at Edinboro, a town somewhat removed from the influence of Lake Erie although only fifteen miles distant, the frost-free period averaged 153 days, while during the same three years the season at Erie ran 191 days, a difference of more than five weeks. It is unlikely that rivers and ponds have any marked effect upon the season of nearby farm land, since their waters change temperature quickly due to their shallowness, except that fog from such waters may at times help to prevent frost.

Air Drainage. Of the more local climatic features, one of the most important is the relative frostiness of depressions as compared with higher land close by. Hollows into which cold air settles and is not permitted to drain out due to enclosure of surrounding hills or woods, are naturally subject to frosts and are unsuited to extra early or very late crops. A difference of a few feet in elevation may, when air drainage is poor, cause the loss of crops which only a hundred feet away come through safely.

Cultivation Relative to Frost Injury. An onion grower who operates on level land near Linesville reports another cause of frost injury. He states that when late spring frosts occur crops that have not yet been cultivated are safer than those that have been worked. This is probably due to the fact that the drier surface soil of the cultivated field loses heat more rapidly than the damp soil of the uncultivated tract, and therefore reaches a lower temperature on frosty nights.

Exposure to Wind. Exposure to wind is of much importance in the case of some tender crops. When high ridges shut off cold winds in the spring, soils are apt to heat up earlier in the season, and the plants set out are not damaged by twisting and tearing in the wind. Some growers plow their land in small ridges and plant in the south side of these, partly for protection from the cold north winds, partly to get the benefit of a southern slope as mentioned below. Windbreaks are commonly used to break the force of cold winds, especially when growing crops in hotbeds and coldframes. Living trees are probably preferable for this purpose to tight board fences since they do not wholly prevent the circulation of air. In the still air close to the lee side of a dense windbreak or fence, crops frequently suffer from frost since frosts favor quiet air. In Pennsylvania the effects of wind are especially felt on the relatively level but high and exposed Allegheny plateau in the central part of the State.

Exposure of Land to Sunlight. With respect to the temperature of the soil the exposure of a piece of land to the several points of the compass is of importance. It is common knowledge that a south slope is warmer than a north slope, even excluding the effect of the winds. This is due to the fact that the land sloping toward the morning sun gets more heat rays on each square foot than does level land or land sloping toward the north. It is well illustrated by the fact that on two adjoining vegetable farms near Sunbury, the tomatoes on one farm grown on the south slope regularly reach the market a week or more ahead of those grown on the other farm on a northwest slope, though all other conditions relating to the crop are identical. A German investigator found that on slopes directed to the four points of the compass, the temperatures were as follows, the figures representing the average from June to October:

South slope	58.02 degrees F.
East slope	57.98 degrees F.
West slope	57.82 degrees F.
North slope	56.34 degrees F.

Southwest and southeast slopes gave nearly the same temperatures and so did northwest and northeast exposures.

The extent to which some of the various causes previously mentioned affect the actual climate of Pennsylvania is shown in the following tables, which have been taken from official records of the government weather service. In any locality the lay of the land on a given farm and the type of soil may render of small importance minor differences in rainfall, temperature, etc. that exist between that farm and another located elsewhere in the State.

The first table gives figures on the length of the period free from frost or freezing temperatures, for a number of Pennsylvania cities and towns. The frost-free period is not the same as the growing season, at least with the hardier vegetables, because such crops may survive frost and grow several weeks after frost in the fall, and may be planted several weeks before danger from frost is over in the spring. The frost-free period is of interest to all farmers, and their practices gradually adapt themselves to the average length of this period, when its length has been found by experience. The policy of general farmers, however, is always of necessity a conservative one, because they gain little by bringing a crop to maturity at an extremely early date, nor do they need to gamble with fall frosts in the effort to strike a favorable late market, as vegetable growers often do.

The figures given in the table below do not give entirely accurate comparisons since in some cases the records cover as short a period as nine years, the same calendar years may not be used when comparing an average with other averages, and these figures are taken only from the records of the years 1901 to 1920. However the data are of sufficient accuracy to show large variation in season through different parts of the State.

Table 1.
SEASONAL CHARACTERISTICS OF VARIOUS POINTS IN PENNSYLVANIA

City	County	Elevation	Frost-free period days	Years of record	Shortest period	Longest period	*Planting date hardy crops	Earliest fall killing frost	Latest spring killing frost
Altoona	Blair	1605	148	16	109	186	May 14	Sept. 11	May 29
Bethlehem	Northampton	295	183	10	155	209	April 27	Sept. 28	May 6
Brookville	Jefferson	1173	118	9	91	152	June 1	Sept. 3	June 24
Clearfield	Clearfield	1122	127	9	91	160	May 23	Sept. 10	June 23
Coatesville	Chester	380	177	19	163	206	May 2	Sept. 11	May 12
Erie	Erie	713	196	18	155	233	April 27	Sept. 22	May 16
Gettysburg	Adams	600	177	16	155	196	May 7	Sept. 22	May 12
Greensburg	Westmoreland	1150	150	12	108	179	May 13	Sept. 19	May 26
Greenville	Mercer	950	133	13	96	163	June 7	Sept. 14	June 17
Hanover	York	600	161	16	141	205	May 13	Sept. 30	May 21
Harrisburg	Dauphin	361	201	18	163	225	April 19	Oct. 12	May 12
Huntingdon	Huntingdon	650	143	18	93	175	May 27	Sept. 10	June 16
Johnstown	Cambria	1184	154	18	108	190	May 25	Sept. 11	June 24
Kennett Square	Chester	340	184	13	147	207	May 24	Oct. 8	May 29
Lancaster	Lancaster	255	167	10	137	197	May 13	Sept. 11	May 27
Lebanon	Lebanon	469	163	18	135	182	May 15	Sept. 22	May 29
Lewisburg	Union	450	159	19	133	179	May 13	Sept. 11	May 29
Lock Haven	Clinton	560	161	17	135	179	May 15	Sept. 22	May 29
Mauch Chunk	Carbon	600	159	18	130	191	May 7	Sept. 11	May 29
Mifflintown	Juniata	445	146	16	97	169	May 17	Sept. 11	June 10
Montrose	Susquehanna	1658	135	15	97	166	May 22	Sept. 12	June 9
Philadelphia	Philadelphia	117	213	19	185	254	April 9	Oct. 3	May 21
Pittsburgh	Allegheny	842	183	19	142	225	April 23	Sept. 10	May 28
Reading	Berks	325	194	16	170	219	April 27	Oct. 13	May 8
Scranton	Lackawanna	805	180	19	155	213	April 23	Sept. 22	May 30
Selinsgrove	Snyder	455	145	19	108	173	May 22	Sept. 6	June 10
Somerset	Somerset	2280	133	19	84	171	May 28	Sept. 11	June 17
Stroudsburg	Monroe	425	141	9	110	168	May 17	Sept. 11	May 27
Towanda	Bradford	454	151	19	117	176	May 14	Sept. 11	May 27
Warren	Warren	1180	139	18	92	189	May 26	Sept. 10	June 24
Wellsboro	Tioga	1419	121	18	89	150	June 5	Sept. 6	June 20
West Chester	Chester	455	188	15	166	221	April 24	Sept. 22	May 12
Williamsport	Lycoming	521	169	18	122	198	May 6	Sept. 22	June 1
York	York	400	173	8	158	193	May 7	Sept. 11	May 16

*This column records, for the few years under consideration, the date on which the chances were four to one that no further killing frost or freezing temperature would occur. That is, in four years out of five, hardy crops were safe from severe frost after this date. Local frosts severe enough to kill tender crops are not included here.

The most suprising fact shown by this table is the variation in the length of season in the different parts of the state. The extremes, among the few cities here listed, are Philadelphia and Brookville, the former city enjoying, during the same years for which records are available for Brookville, a frost-free period 94 days, or over three months, longer than the latter city enjoyed. In general, latitude and elevation are responsible for the greater part of the difference in length of season, tho the direction of the prevailing winds is also of importance. The effect of Lake Erie on the climate near its shores is largely responsible for the long season at Erie.

Spring frosts are of interest to vegetable growers because they affect the early planting of crops, determining rather definitely the date when it is safe to plant the various groups of vegetables, from the hardiest to the most tender. Most gardeners do not wait until all danger of frost is over. They plant rather when the chances are strongly against there being further severe frosts, as they are willing to take a reasonable chance in order to get a good start for the season. If this were not so their long season crops might not mature before fall frosts caught them. At Philadelphia, for example, a severe frost has been recorded for May 21 in one year, and yet on the average in and near that city hardy crops are fairly safe from frosts if they are planted after April 9. Growers would of course be unwise to wait until May 21, because the more venturesome planters would get crops to market first in all the years when spring began earlier. The same thing is true of any point in the State; for every section there is probably an absolutely safe date when no frosts can occur, and also a reasonably safe date when the risk is good that crops will be safe. Weather records for a hundred years would not fix definitely the first date, but records for a few years suggest what the reasonably safe date may be.

Summer Rainfall Should Be Considered

The following tables of rainfall are taken from part 5 of the Water Resources Inventory Report of the Water Supply Commission of Pennsylvania, which records monthly precipitation at a large number of points in the State. Records are here given only for the four summer months, June to September, since these are the periods during which most vegetable crops make their growth. Droughts occur in April and May but are less serious than later due to the reserve supply of water stored in the soil during the winter and the lower evaporation due to lower temperature in the spring. Dry weather later than September is of little consequence to the majority of vegetable growers.

The average rainfall as given is of interest chiefly in showing that there is a noticeable difference among the cities listed in regard to

summer rainfall. Altoona, Erie, and Pittsburgh appear to have the lowest rainfall in summer, and at these points too, as well as in other districts, the rainfall lessens after July; while in other cases August rains are heavier than July. In all localities but one September rainfall is the lowest of all four months, and the fall months are, in Pennsylvania, the driest of the year.

Of more importance to the vegetable producer than the average rainfall is the likelihood of dry weather during the growing season. We may to some extent judge the likelihood of droughts by the occurrence of months with deficient rainfall either singly or in pairs. This is far from a perfect method since a low rainfall for one month, if properly distributed, may fill the requirements of the crops; while a normal rainfall in another month, if it all comes within a few days, may not prevent loss from dryness at the other end of the month. When two consecutive months are dry however, it may be fairly certain that all crops will suffer.

Columns 1, 2 and 3 in the table illustrate three methods of judging the tendency toward dryness in any locality. If less than two inches of rain falls during a summer month in Pennsylvania one may safely guess that many vegetable crops will not do their best. Again, if less than one inch of rain falls, any month may be called decidedly dry. Drought is still more certain if rainfall is deficient during two consecutive months. In the columns referred to, the numbers represent the average number of months during the average period of ten years (a decade) when the given condition prevailed during the four summer months. For example, in any decade at Altoona it is fairly certain that nine (8.9) summer months will have less than two inches of rain; that only one month in the ten years will have less than one inch of rain; and that in the case of three or more of the nine months the preceding months also will be somewhat dry.

The question of the probability of summer drought is interesting and important when considered in connection with:

1. The need and economy of artificial irrigation.

Where one locality is shown to be so much drier during the summer than another, the rainfall records would seem to indicate the greater need of irrigation in the drier section.

2. The substitution of green manures and commercial fertilizers for animal manures.

The sections having the best rainfall records should be able to make the best use of commercial fertilizers and decaying cover crops, should irrigation not be used. Those districts having the greatest rainfall records for August and September should offer the largest chances of success with green manuring crops that are sown in late summer or fall.

Table 2.

SUMMER RAINFALL IN PENNSYLVANIA

City	County	Length of record, yrs.	Average rain fall for each month in inches June, July, August, Sept., Total.					1 Months per decade during which less than two inches of rain fell, June to September.	2 Months per decade in which less than one inch of rain fell, June to September.	3 Months per decade with less than two inches of rain and with deficient rain also in preceding month.
Altoona	Blair	29	3.70	3.29	3.18	2.71	12.88	8.9	1.0	3.1
Bethlehem	Northampton	31	4.22	4.28	4.52	3.51	16.53	5.9	1.9	3.3
Easton	Northampton	31	3.73	4.68	4.65	3.82	16.88	4.9	1.0	2.6
Erie	Erie	43	3.50	3.09	3.41	3.49	13.49	7.7	1.6	4.1
Harrisburg	Dauphin	45	4.01	3.83	4.21	3.25	15.30	8.0	1.3	4.2
Huntingdon	Huntingdon	37	4.30	3.78	4.01	3.45	15.54	4.0	1.3	2.3
Johnstown	Cambria	34	5.10	4.51	4.39	3.58	17.58	4.9	0.6	3.0
Lancaster	Lancaster	17	4.14	4.06	4.28	3.77	16.25	5.4	0.6	2.4
Lansdale	Montgomery	27	3.43	4.34	4.95	3.42	16.14	8.1	2.7	4.0
Lebanon	Lebanon	32*	3.90	4.29	4.72	3.14	16.05	7.6	3.0	3.7
Lewisburg	Union	39	4.03	4.01	4.71	3.48	16.28	4.3	0.5	2.3
Lock Haven	Clinton	27	4.20	4.02	4.09	3.56	15.87	5.4	1.1	3.3
Morrisville	Bucks	38#	3.90	3.97	4.61	3.17	15.65	7.8	1.3	6.3
New Castle	Lawrence	26	4.27	4.26	3.05	3.11	14.69	9.3	3.0	4.2
Philadelphia	Philadelphia	96	3.68	4.06	4.48	3.49	15.71	8.3	2.5	4.2
Pittsburgh	Allegheny	71	3.70	3.88	3.22	2.81	13.61	9.1	1.0	5.0
Pottsville	Schuylkill	33	4.22	5.01	5.39	3.82	18.50	4.8	1.2	3.4
Scranton	Lackawanna	20	3.51	3.71	3.78	3.13	14.13	8.0	0.0	5.0
Warren	Warren	27	4.06	5.03	4.23	3.67	16.99	5.5	0.4	3.3
West Chester	Chester	56	4.18	4.80	4.72	4.13	17.83	6.9	1.7	4.3
Wilkes-Barre	Luzerne	30	3.92	4.10	3.98	3.22	15.22	7.6	1.2	3.9
Williamsport	Lycoming	28	3.60	3.99	4.19	2.97	14.75	7.1	2.0	3.9
York	York	28	3.57	4.42	4.32	3.32	15.63	7.1	1.2	4.5

*From 1883 only.
From 1842 to 1887.

Other facts of interest may be gathered from the weather bureau records. The proportion of cloudy to clear days is of special interest to the grower of vegetables under glass, as is the prevalence of storms and heavy snows as they affect the expense of construction and upkeep of the greenhouses. In some localities the annual snowfall may affect the safety of crops wintered out of doors. Where hotbeds and coldframes are extensively used the March and April temperatures will affect the heat needed for hotbeds and the amount of extra cover as mats or shutters needed. In fact all phases of local climate are found to affect the success of vegetable growing enterprises.

IRRIGATION PRACTICED TO SOME EXTENT

The matter of irrigating vegetable crops in Pennsylvania has apparently not received the attention that its value justifies. Surface irrigation is used on only a few farms since the topography of the land in many cases prohibits it. Sub-irrigation is possible on some farms where ditch or tile drains may be closed up when desired to temporarily raise the water table, as on certain muck areas in Northeastern counties. The overhead system of irrigation may be considered the ideal type in this state, under most conditions. Yet there are not over 300 acres of vegetable gardens in Pennsylvania watered in this way. The main sections where overhead irrigation is used are the market gardening regions near Philadelphia, Wilkes-Barre and Pittsburgh.

Near Philadelphia seven growers have a total of 68 acres under permanent watering lines. In Allegheny County the area irrigated runs under 50 acres, while in Luzerne County, nine growers of the Wilkes-Barre district can control the moisture supply on 63 acres, through the use chiefly of lines of the portable type.

Fig. 3. Land under irrigation, Bustleton section, crops of lettuce and celery.

Irrigation In Intensive Sections

The value of overhead irrigation to the market gardener will depend upon the soil, the location of the farm with regard to rainfall and exposure; the crops grown, and other factors. Artificial watering is considered of most value on light, sandy soils, yet practically all the irrigated farms in Philadelphia County have clay loams. It is true that on heavily manured land, irrigation is less necessary than on poorer soils because the manured land will hold moisture well during the summer months.

The truck farmer who produces vegetables on an extensive scale and usually limits the number of crops can use irrigation to less advantage than the market gardener who generally grows miscellaneous crops right through the season. Water is needed in Pennsylvania especially for the moisture-loving vegetable crops as spinach, lettuce, celery and Chinese cabbage, grown through such dry months as August and September.

Earliness of maturity, larger yields, ability to plant seeds or plants at any time regardless of weather conditions, and crop insurance are the benefits from irrigation emphasized by Pennsylvania growers.

Initial expense as well as the cost of the water must be figured upon in considering an irrigation system. But it is doubtful whether there are many cases where irrigation will not pay for itself in intensive gardening areas. Though the system may not be of great value every year, yet it is insurance against drought that may save total loss of certain crops in dry years.

The portable type of overhead sprinkling lines is becoming more popular than permanent lines due mainly to lower cost of equipment and installation, and to the fact that the lines may be removed to facilitate plowing or other operations. A Wilkes-Barre grower has designed satisfactory wooden tripods to serve as supports for the portable lines.

LIME USED FREELY IN VEGETABLE GROWING

Out of 800 vegetable growers who reported in the survey, some four hundred stated that they were accustomed to using lime occasionally on their land. Of these, few were using lime specifically for vegetables, but were rather applying it to general farm crops in the regular farm rotation in which a vegetable crop appeared at some point. From the fact that no systematic plan is followed in the use of lime, the growth of crops in the rotation is the means of judging the need for this material. Where lime is used at regular intervals, the length of time between applications commonly ranges from four to five years. It was reported that ground limestone was the most common type used, hydrated lime second, while smaller numbers

used burned lime and oyster shells. The last form mentioned is of importance only in the southeastern counties.

Although the use of lime has become pretty firmly established as an approved means of soil improvement on general farms, lime has until recent years played a smaller part in vegetable growing. This is due to several causes:

1. Little has been known of the exact needs of the vegetable crops for lime. Probably the most accurate classification that has yet been made was published by the Rhode Island Experiment Station. The crops are classed into four groups, those in the first group seeming to need no more lime than the common farm crops excluding red clover and alfalfa, while those in the last group (No. 4) seem to need lime in considerable amounts, either for its direct action on the plants or indirectly through its effects on the soil and soil organisms.

Group 1.	Group 2.	Group 3.	Group 4.
Beans	Brussels Sprouts	Broccoli	Asparagus
Chicory	Carrots	Cabbage	Beets
Corn	Collards	Cauliflower	Celery
Cress	Cucumbers	Chard	Okra
Parsley	Dandelion	Egg Plant	Leek
Radish	Endive	Horse Radish	Lettuce
Tomato	Kale	Martynia	Onion
Turnip	Kohl Rabi	Muskmelon	Parsnip
Watermelon*	Peas	Mustard	Pepper
	Pumpkins		Salsify
	Rhubarb		Spinach
	Squash		

2. Fertilization methods on intensive market gardens are such that high degrees of soil acidity are not likely to be attained; or if soil is acid, acidity is not of such great importance due to the great abundance of plant food present and the high condition of soils from the organic material added.

Under general trucking conditions in Pennsylvania, an application of lime once in a 4 or 5 year rotation in which one vegetable crop appears, is probably enough. It is a question how frequently lime is necessary in more intensive market gardening, but the trend is toward the greater use of lime in sections as Philadelphia and Wilkes-Barre. Such increase is no doubt partly due to the larger plantings of lime-needing vegetables as celery and spinach and the fact that less animal manure and more commercial fertilizer is being used.

Pennsylvania is unusually well supplied with limestone so that it is comparatively easy for growers to secure lime at a reasonable cost. Limestone occurs in every county except those of the northern tier, Crawford and Pike Counties, and in the hard coal region. Pulverized limestone is now the most popular form, but hydrated lime sales are pushed by the dealers. "Plant lime," a by-product in the

*Watermelons are usually positively injured by lime applications.

recovery of magnesia from limestone, is sold in the western part of the state. Calcareous marl is also quarried as a source of lime at Conneaut Lake in Crawford County and workable beds of this form occur frequently in many of the limestone sections but have been little developed.

FERTILIZER FOR VEGETABLES

Although large quantities of commercial fertilizers are used annually in Pennsylvania, the State has no natural sources of these fertilizers, unless its abundant supply of limestone may be classed as one. Even in the adjacent states there are no natural fertilizing materials, except in New Jersey where greensand marl has been used locally for many years as a source of potash. So far as is known very little if any of this material is used in Pennsylvania for soil improvement.

Pennsylvania does have, however, a considerable present resource, and a prospect of a much greater one in the future, in the manufacture of sulphate of ammonia as a by-product of the coke industry. During the war potash was obtained in considerable amounts from some of the waste products of Pennsylvania factories, especially from cement mills and blast furnaces.

As near as Niagara Falls, N. Y., an interesting nitrogen compound is made, calcium cyanamid. This fertilizer is assuming importance, since as long as cheap water power can be had, the supply cannot be exhausted. There are, however, difficulties attending its use by inexperienced persons, and its value must be more fully understood before it is used extensively.

Pennsylvania growers are within easy freight hauls of the leading distributing points for fertilizers in the East, Baltimore, Philadelphia and New York. Within the State, York, Lancaster, and Reading are seats of thriving fertilizer mixing industries. At Johnstown and Pittsburgh several brands of tankage are made and a Reading firm prepares bone meal. There are, of course, in every large town, and in many of the small towns surrounded by thriving agricultural country, dealers who provide many sorts of commercial fertilizers. Acid phosphate is the chief material handled but most retailers are now furnishing nitrogen, potash, and high grade mixed fertilizers as well.

Animal Manure Plays Important Part

In stable and chicken manures Pennsylvania is rich. The dairy farms of the State produce large amounts of cattle manure while many of the farm gardeners depend largely on chicken and hog manures for their vegetable plant food. The farm trucker has had to worry little about his garden manure supply since the farm dairy

or work animals furnish manure for his vegetable crops as well as small amounts for the rest of the farm. The market gardener near the cities is the one who now notices the manure shortage. He must often pay from five to six dollars per ton for manure shipped by carload and then cannot get the supply he would like to use. There is no reason to expect that city manure will ever become more plentiful than it is now. Possible remedies for the present shortage of supply do not include the development of new supplies of manure, but rather the substitution of new plans for old ones in the fertilization of vegetable farms and gardens.

Green Manures Now Used Extensively

Green manuring crops are becoming increasingly important in Pennsylvania vegetable growing. The principal reason for this is the scarcity and high price of animal manures and the objection to weeds introduced in the fresh animal manures. A few years ago it was thought almost impossible to grow profitable crops of vegetables, especially the small crops as celery and lettuce, without the use of animal manures.

A Philadelphia grower has shown conclusively that excellent celery may be produced on soil in which organic matter is supplied through sweet clover. Luzerne County growers now make much use of a rye-vetch combination. One Wilkes-Barre gardener has grown excellent vegetables for eight years or more using only sweet clover

Fig. 4. Rye in corn stubble. Preparing the land for better vegetable crops.

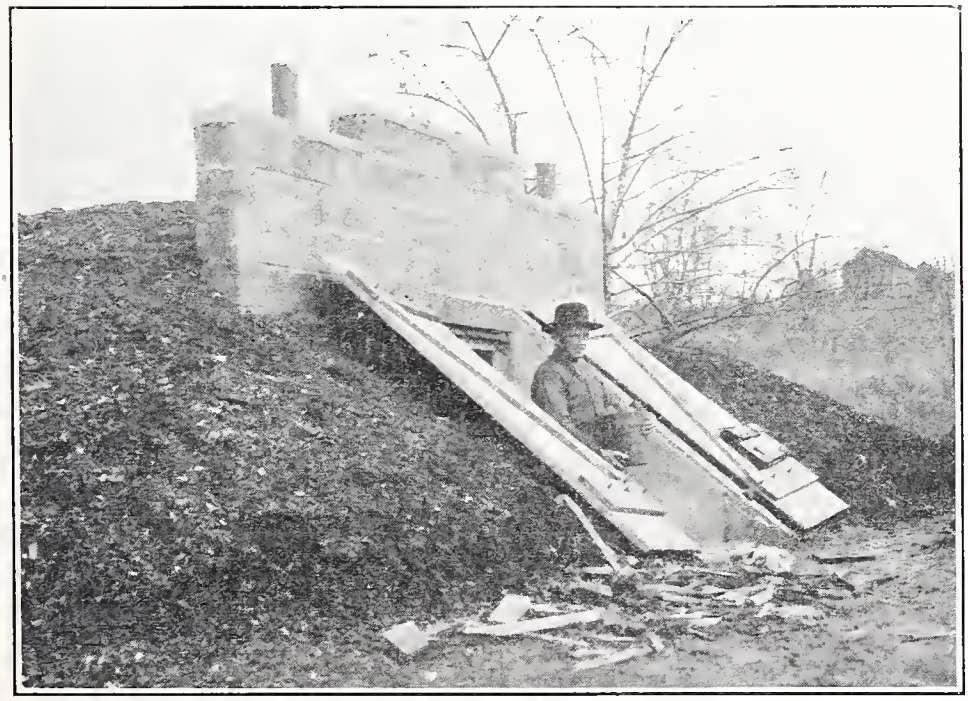
and vetch and commercial fertilizer. Crop yields have doubled on this land in that period. Oats has played a part in some sections as a soil builder. Asparagus growers in lower Bucks County are trying to keep their asparagus soil built up through the turning under of such cover crops as soy beans and barley in old plantings and wheat in newly set fields. Throughout the state the results secured from the substitution of green manures for animal manures have been encouraging.

FIELD STORAGE IS COMMON PRACTICE

There are few permanent storage buildings located on Pennsylvania vegetable farms. Most of the gardeners in this state, who store any vegetables, depend upon field storage pits or trenches for the winter sales' supply of roots, cabbage and celery. A very few take advantage of cold storage warehouses in the nearest city.

While field storage is inexpensive so far as construction is concerned, losses due to irregular temperatures make the final cost of such storage considerable. Far preferable are permanent concrete cellars which are here illustrated and their requirements briefly described by Mr. N. S. Grubbs of the Portland Cement Association's Educational Department.

"The large bulk of Pennsylvania's crops to be stored require a storage structure properly designed, properly located, properly made, properly filled and properly operated. Good disease-free produce

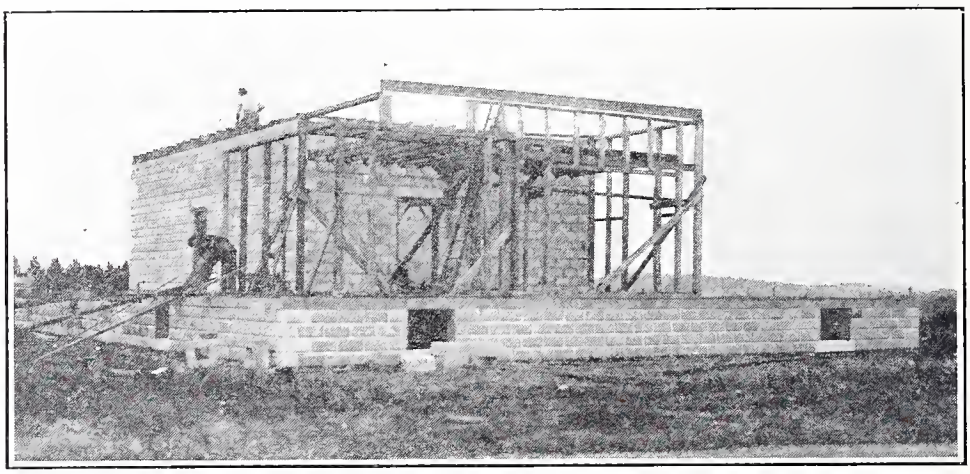


(Courtesy Portland Cement Association)

Fig. 5. Concrete, cinder block, underground storage house in southern Pennsylvania.

only should occupy space in any cellar. Most crops from the vegetable garden will store in underground storages that are frost-proof, durable, well ventilated and correctly drained. A few vegetables such as onions, pumpkins, squash, etc., require special storage conditions other than those proper for the root crops.

"In planning the underground cellar (figure 5.) it is found that 2½ feet of soil covering will be sufficient insulation to exclude frost. The walls, supporting the roof, should be supported on a well-drained footing and if made of concrete can be solid monolithic, hollow block or of the double type containing an air space. If a concrete roof slab is to be used it should be made of carefully selected, clean materials, thoroughly mixed and reinforced with sufficient steel to make the structure strong and watertight.



(Courtesy of Portland Cement Association)

Fig. 6. Above and below ground storage house, located for roadside marketing.

"For the ventilation system (Fig. 6) it is advisable to provide the cellar with a large driveway door to be used to regulate the supply of fresh air. Usually a large outlet in the roof at the opposite end, provided with a means of closing, will insure satisfactory and simple system of ventilation. For the most part ventilation controls the moisture of the cellar and has very little effect upon the temperature. The amount of humidity will vary. The secret of success in the storage of most vegetables is to know and maintain the correct amount of humidity which is best adopted for the particular crop in storage.

"The temperature follows pretty closely the temperature of the soil surrounding the walls and the floor.

"If an earth floor (Figure 7.) is desired it should be covered with a raised wooden floor of boards or slats separated to permit air circulation. Usually a floor raised 8 or 10 inches will be satisfactory."

Efficient storage should mean much to Pennsylvania vegetable growers through the avoidance of gluts in the fall, the maintenance

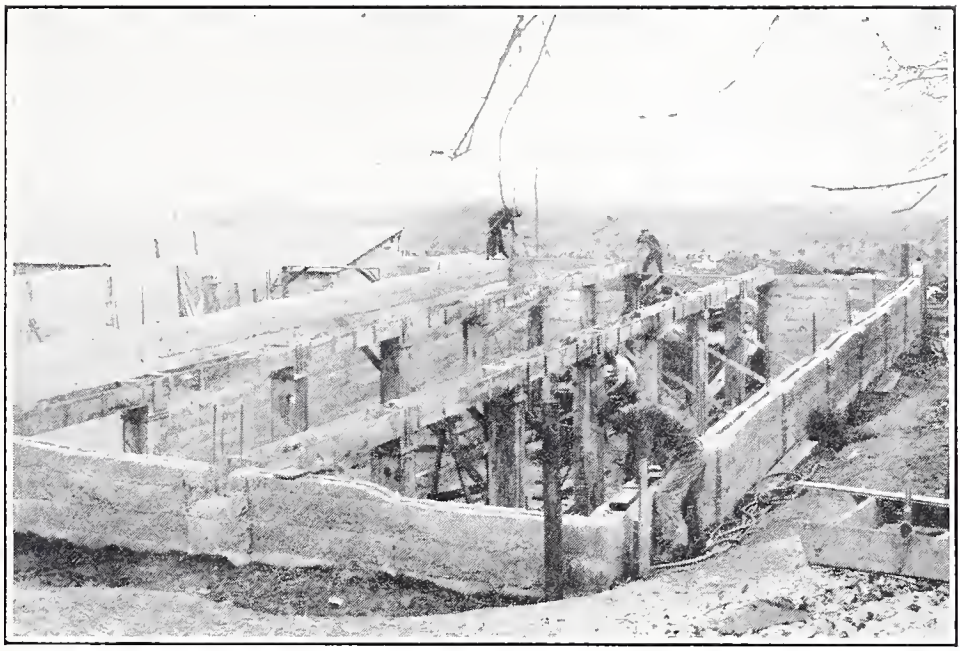


Fig. 7. Permanent potato and vegetable cellar under construction at the Pennsylvania State College. Total capacity more than 16,000 bushels.

of a vegetable trade over a longer season, and the elimination of such losses as are furthered by field storage.

INDUSTRIES INFLUENCE VEGETABLE GROWING

Pennsylvania is more widely known, although not with entire justification, as an industrial state than as an agricultural state and for this reason no survey of Pennsylvania vegetable growing would be complete if it did not consider the relations of manufacturing and mining to the business of vegetable growing, since these industries have effects quite distinct from the mere providing of many mouths to be fed. These effects may be mentioned briefly as follows:

1. Labor competition between the factories and mines and commercial vegetable growers tends to increase as industrial plants develop. The high wages offered by the city industries are often better than the farmer can offer. Such competition tends to discourage to some extent the growing of vegetables near the larger cities and explains in part the large importation of vegetables from other states into cities like Pittsburgh, Sharon, and Johnstown.

2. The industries of Pennsylvania and the dense populations resulting are located with little regard as to their food supply, but rather with consideration as to sources of raw materials and convenience of transportation. Although the cities have sought the stream valleys, only occasionally as at Wilkes-Barre have there been found bottom land soils in sufficient amount to influence the vegetable supply. Coal

towns as well as many manufacturing cities are located in country with natural resources very poorly adapted to vegetable growing.

3. The type of work and the class of workers required influence the particular vegetables grown. Heavy manual labor has been thought to demand in the worker's diet a greater proportion of cabbage, potatoes, and other substantial foods than those of the salads and more delicate foods such as are used in centers calling for labor of less physical and more intellectual type. Particular groups of workers from different European countries use garlic, peppers, tomatoes, and red cabbage to a far greater extent than the general run of the native born population. New ideas regarding the necessity of "greens" and bulky vegetables in the diet are now influencing the demand for such vegetables.

MANY VEGETABLES IMPORTED

There are several causes, besides the influence of industries, for the extensive importation of vegetables into Pennsylvania.

1. The fluctuating supply of locally grown vegetables upon the smaller markets influences the retailers to purchase their vegetables from wholesalers in the large cities, from whom they can get a steady supply, rather than from local growers who offer produce only a few weeks in the year. The towns of less than 10,000 population seldom attract the strictly commercial vegetable growers. An irregular supply comes from the farm gardens or small truck plots where crops are grown primarily to suit the home table; in some years little is grown because of low prices the previous year; the less easily raised vegetables, as celery and cauliflower, are seldom grown; while due to lack of storage facilities, little is provided for winter sales.

2. Poor grading of Pennsylvania vegetables furnished by the small trucker encourages the retailer to order from the wholesaler in order to get a uniform product.

3. The states immediately surrounding Pennsylvania are large producers of vegetables, and by reason of superior soil or climate in some cases, or economy or economy of transportation in others, importation of vegetables from these states into Pennsylvania will continue.

4. People demand out of season vegetables and this means either growing in the artificial conditions of the greenhouses of Pennsylvania or other states, or in the mild winter climate of such states as California and Florida.

5. Pennsylvania soil and climate are suited in only restricted localities to the economical production of sweet potatoes, watermelons, and muskmelons. These crops are grown in Pennsylvania in a limited way but the demand through much of the season must be met by supplies from other states.

Importation of vegetables will continue and increase as long as imported vegetables are better graded than home grown products, for the dealers must serve their customers with the best if they are to stay in the business. Probably, too, Pennsylvania growers to hold or gain their market must sell over a longer season through the greater use of glass in the spring and storage in winter.

CLASSES OF VEGETABLE GROWERS

The vegetable producers who supply Pennsylvania tables with home grown vegetables may be grouped under seven fairly distinct heads. It must be understood, however, that the groups grade into one another to a certain degree, and that a grower may be included in one class one year and in another in other years, according to the extent of his operations.

1. HOME GARDENS.

Home gardens in towns and on farms probably produce one-fifth of the vegetables grown in the state for home use. In Pittsburgh and its suburbs it has been estimated that from 3000 to 4000 acres of land are used for amateur home gardens. In Philadelphia and vicinity the acreage is perhaps higher. Every large city can boast of an acreage and a production from backyard gardens which would surprise the average citizen. In the open country eighty out of every hundred farms have vegetable gardens of greater or less extent, and these sometimes provide more than the farm families require.

Not all cities are well located or properly laid out for the greatest development of home gardens. Few cities of the state have as many gardens in proportion to population as has Erie, which because of the excellent quality of its soil and the average large size of lots offers exceptional opportunities to home gardeners. Many of the non-industrial small towns such as Mercer and Clearfield, also show the highest development of home gardens. In the more confined industrial centers like Mauch Chunk and Renovo there is less room for gardening altho even in these cities, as in all sections where there is a large foreign-born population, every inch of soil, even tho it may be hilly, stony, or poorly drained, is used, little or none being saved for grass and flowers. The use of such apparently worthless land is of the highest interest in Pennsylvania vegetable growing because it points to a probable change in the nationality of vegetable growers in every neighborhood where it is well under way. This development is going on at Johnstown and at Wilkes-Barre, and these cities may expect, what other eastern cities have found, that in the course of twenty years an almost complete change in the nationality of the local vegetable growers may take place.

Home gardeners do offer some competition to the commercial men, especially on the smaller markets. In the country the farm garden supplies many of the common vegetables for both summer use and canning. However the farm garden frequently lacks the variety of produce that is desirable for health and the stimulation of appetite and also may be too small to furnish the proper supply of vegetables for the season, especially as regards late vegetables for storage. Vegetables that are less commonly grown by local home gardeners as melons and celery are usually furnished by commercial vegetable growers. The city and town gardens likewise are most productive in spring and early summer and later in the season furnish mainly cabbage and tomatoes. They usually have little surplus of most vegetables for canning so that such produce offers an opportunity for the commercial grower.

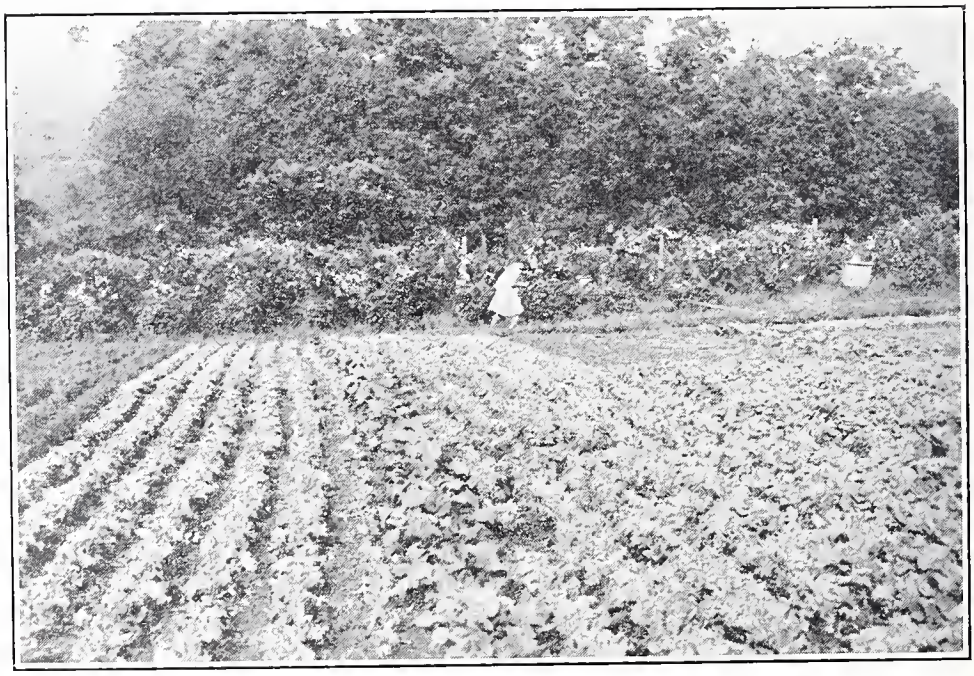


Fig. 8. Large farm garden in Center County from which a considerable surplus of vegetables and small fruits goes to local markets.

One feature of the home gardening situation of special interest is the customary reduction of town home gardens in number and size during periods of marked business prosperity, and a corresponding increase when business is slack. The recent war furnished an exception to this rule, because it provided a special motive for gardening even though wages were high. In ordinary times the effect on the grower is to increase his sales and profits in boom times and unduly decrease them in times of depression. For this reason market gardening, which depends for its profits upon those crops in which

the home gardens offer some competition, is subject to greater fluctuations in sales and profits as a result of business changes than is almost any other branch of agriculture.

2. MARKET GARDENS OF LESS THAN TWO ACRES.

A second class of vegetable growers includes the small gardeners whose business is in many cases the outgrowth of successful home gardens from which an occasional surplus has been disposed of to neighbors or has been traded in at the store. Two or three city lots thrown together, or even operated separately, provide enough land to keep a young man or woman busy much of the time. In the country the home garden is found to be a source of pin money, and its area is increased until it becomes a full-fledged market garden, generally operated by the women of the family, by young people, or by older men who have passed the age of active service in grain and hay fields.

The small market garden is apt to have a few hotbed or cold frame sash, provision for artificial watering by hose or overhead pipe, sometimes a small greenhouse in which plants are grown in spring as a side line, and among the gardener's equipment will be found at least a wheel hoe and often a seed drill. The crops will include some of those less easily grown, such as celery, or summer lettuce, or perhaps one of these will be made a specialty. Sales are all made locally, often at the door of the operator, and the personal contact under this type of gardening offers one of its most distinct advantages.

In Pennsylvania, cities of around ten thousand population are largely supplied by these gardeners operating two acres or less and in the larger cities where genuine farmers' markets are in existence, they make use of three-fourths of the stalls. Of all the vegetables grown in Pennsylvania for local sale in the fresh condition, fully fifty per cent are grown in market gardens of this class.

3. FARM TRUCK GARDENS.

Somewhat like the preceding group, but distinguished from it chiefly by the nature of the crops grown, is the number of farm truckers who grow an acre or two of one or several vegetable crops. Every coal mining county of the state can boast of numerous cabbage growers with an acre or so in this favorite crop, and near the larger cities tomatoes and sweet corn are frequently grown as specialties by general farmers.

4. CROPS FOR CANNERIES AND EVAPORATING PLANTS

Growers of crops for canning and drying make up a separate class chiefly because they specialize usually with one crop and because their selling method is different from that of other growers. Truck growing for canning reaches its greatest development in York Coun-

ty, but active canneries are operated in Adams, Chester, Franklin, Delaware, Erie and Columbia counties. Corn growing for evaporating is carried on chiefly in Lancaster County. Of the canning crops tomatoes take the lead in importance, while sweet corn, peas, string beans, asparagus, spinach, squash and beets are canned in smaller amounts.

5. SPECIAL-CROP TRUCK FARMS.

The special crop truckers include the asparagus growers of Bucks and Erie Counties, the onion growers of Crawford County, the celery growers on muck soils in Tioga, Bradford, and Wayne Counties, and late cabbage growers in Indiana, Jefferson, and Erie Counties. These producers are placed in a separate group because they grow but one crop, grow it on a comparatively large scale and often on special soils, and ship in wholesale quantities to other states as well as to Pennsylvania markets.

6. MARKET GARDENS OF MORE THAN TWO ACRES.

Growers handling from two to several hundred acres are generally thought to be the main source of fresh vegetables. In Pennsylvania it is unlikely that gardeners of this class furnish more than 15 per cent of the total supply of vegetables grown in the state for use at home in the fresh condition. At the same time, these larger establishments are of special interest because they exhibit perhaps the gratest skill in growing the crops, the most highly improved land of great cash value, the most intensive growing methods, and the most elaborate equipment and machinery.

The market gardens located often at the very edge of the city have land that is of value not only because heavy annual applications of manure have made the ground surprisingly rich but also because the future growth of the city enhances their cash value as real estate. Labor saving devices as motor cultivators, multiple seeders, washing and bunching equipment, find greatest use in these larger gardens since perhaps only on such farms where solely vegetables are grown, is the labor cost of vegetables even partly understood; also labor costs are apt to be higher near the centers of great population. In this class of vegetable growing are found the larger areas of irrigated garden land and the use of glass sash or greenhouses for extending the growing and marketing season. More diverse crops are handled by the larger than the smaller growers because they have more diverse tastes to satisfy on the large markets and with their fine soil, are better able to produce some of the less easily grown crops. The coarse crops are sweet corn, main crop cabbage, and others that are grown by the truckers within competing distance are not largely planted. In marketing the produce of these gardens the trend is toward wholesale selling.

7. FORCING ESTABLISHMENTS.

The final class of Pennsylvania vegetable growers includes those who grow crops in greenhouses and frames. There are three well defined centers of vegetable forcing in the state, Erie, New Castle, and Kennett Square. Nowhere else in the United States has the business of growing mushrooms attained the size or success of the industry that is centered in Chester County. Both the vegetable forcing and the mushroom industries are described in separate survey bulletins, Pennsylvania Department of Agriculture General Bulletins Nos. 392 and 396.

MARKETING VEGETABLES

Numerous different methods of marketing are used in the State. There is a wide variation between the problems of the large commercial grower, the farmer having only a small surplus of vegetables for sale and the numerous groups of producers who come between these two extremes. In some sections even the local production goes through the usual distribution channels including the commission merchant, jobber and retailer.

The largest group of producers in number are those who sell directly to consumers. Several different methods are in use, depending largely on the location of the farm, the character of the production, and the buying habits of the consumers in the nearby markets.

Fig. 9. Curb market outside of "Broad Street" Market House, Harrisburg.

The public market or market house was perhaps the earliest form of development and in many parts of the state it continues to be a very popular method of marketing. It is especially adapted to the sale of products raised in the gardens of general farms and on the smaller truck or vegetable farms. In addition, many of the commercial growers of vegetables use this outlet for a portion of their products. While most important in the southeastern section of the state, both the market houses and curb markets are quite common in other districts. They seem to be especially successful in sections where there is a considerable industrial population.

Retailing Presents Special Problems

There are a number of problems which are encountered in the retailing of vegetables by producers as well as by dealers. The use of vegetables has increased greatly during the last few years and as a result they are a much more important feature of the food supply than in the past. This expansion in production has come largely in southern and western states where it is possible to produce crops at seasons of the year when there is little or no local competition. A supply of most vegetables is available to the consumer during almost every month of the year. Many consumers purchase products from distant sections to such an extent that their appetites are satisfied before local production begins.

This has made it increasingly difficult to reduce gluts in the markets and at the same time make use of available supplies at reasonable prices for canning and similar purposes. Much can be done by growers in cooperation with retailers and the press to increase the use of local vegetables during the season when they are available.

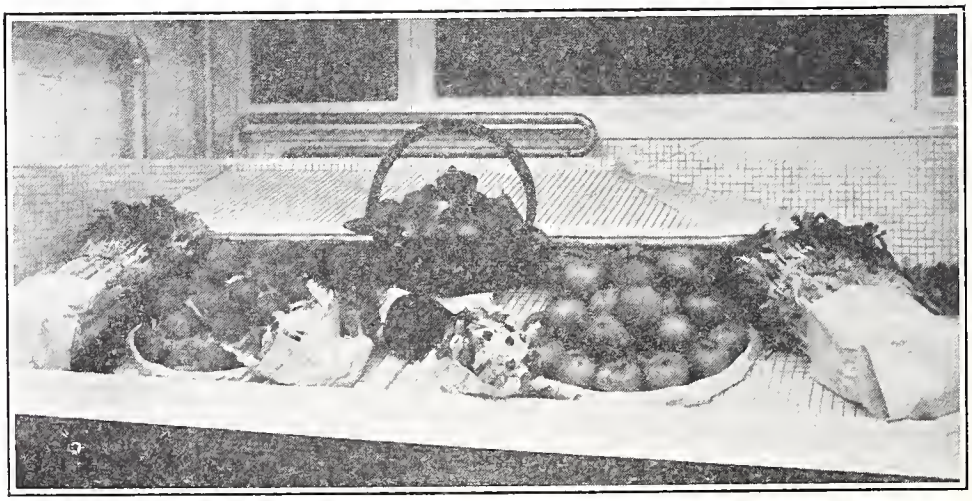


Fig. 10. Attractive displays of vegetables by the retailer which help to increase the purchase and consumption of these crops.

An attractive display of clean, well graded vegetables is one of the best possible selling arguments. Graded products are, of course, in more demand than those which are ungraded. The size of the package in many cases determines whether the consumer will purchase an entire basket or only a portion of it. This is especially true in the case of roadside markets.

The cost of retailing is of importance whether the grower retails his own product or delivers it through other channels. When it is sold to the retailer and the wholesaler the cost of retailing is discounted in the sale price. When the producer sells at retail himself he frequently finds that the cost of retailing is larger than the amount of the discount that would have prevailed if he had sold to a wholesaler or the retailer. This is especially true when the volume of business handled is small and the costs are relatively high. Many farmers find that they must buy products which they do not produce themselves to resell in order to hold customers for their own production.

When vegetables are sold by retailer there is very frequent criticism of prices which are charged as compared with wholesale prices. To some extent this criticism is justified. It must be remembered that small units rarely measure out to the full capacity of the original container. Further losses naturally occur in the more perishable articles as it is often necessary to reduce prices in order to prevent loss from deterioration. If the product has not been well graded the inferior portion must be sold at a lower price. The above points are special features of the retailing of vegetables that do not prevail in the retailing of many food products.

Many Growers Sell Direct to Retailers

Another large group of vegetable growers includes those who sell directly to the retailer in nearby cities. Such men are found over the entire state, and they usually have a sufficient volume of production so as to make it unprofitable for them to attempt to retail it themselves. In the larger cities, especially Philadelphia and Pittsburgh, and in certain of the smaller ones many growers turn over their products to wholesalers or to commission merchants to sell through the usual channels of distribution.

In certain limited sections of the state the production of vegetables is marketed in carlots, shipped either by the producers themselves or by local shippers. This is particularly true in the onion, cabbage, and lettuce districts. Such carlots are usually handled either on commission or sold f. o. b. at loading points. This type of marketing is common in districts where there is considerable production.

Large numbers of mixed cars of products are shipped from Philadelphia, Pittsburgh and Baltimore to the various distributing centers over the state. This furnishes an outlet for products marketed in those centers, but which frequently compete with locally grown produce when they reach the smaller markets. The development of this type of service has made it possible for the jobber in the small city to secure adequate supplies of the necessary vegetables from the larger centers to supplement local production. This form of transportation directly affects local production as the products brought in from the outside are frequently better graded and in more attractive form than those available locally. An interesting variation of this business is the purchasing of mixed cars by summer hotels.

Second-hand Packages Undesirable

The field survey shows that almost every conceivable package was in use in the marketing of Pennsylvania vegetables. These included the recognized vegetable packages such as barrels, hampers, round bottom baskets, splint baskets, boxes and sacks. In addition every possible form of second-hand package was found, the type depending on the supply available in the community. While intended as a means of economy, in all probability the use of such packages is frequently an actual expense to the grower. They are unattractive in appearance, irregular in capacity, easily breakable and usually waste valuable store and truck space.

In the eastern part of the state the hamper is apparently as popular as the splint market basket is in the western part. Competition from adjacent territory outside the state has much to do with this preference.

The size of hamper which is probably most popular is the sixteen quart, but in many sections the fourteen quart has been substituted for it. In those districts close to New Jersey, it is frequently necessary for the growers to pack their products in the twenty quart package, commonly used in New Jersey, in order to sell such products in competition with the Jersey products. There is a variety of sizes of hampers in use in addition to those mentioned above. It is hoped that the standards proposed by existing Federal legislation as shown in Figure 11 will be adopted in the near future, thereby making it possible to eliminate the many confusing sizes of packages now in use.

In the western part of the state the chip or splint basket is in general use. In Erie the twelve quart size is the common one and is used generally for practically all products. In the Pittsburgh market

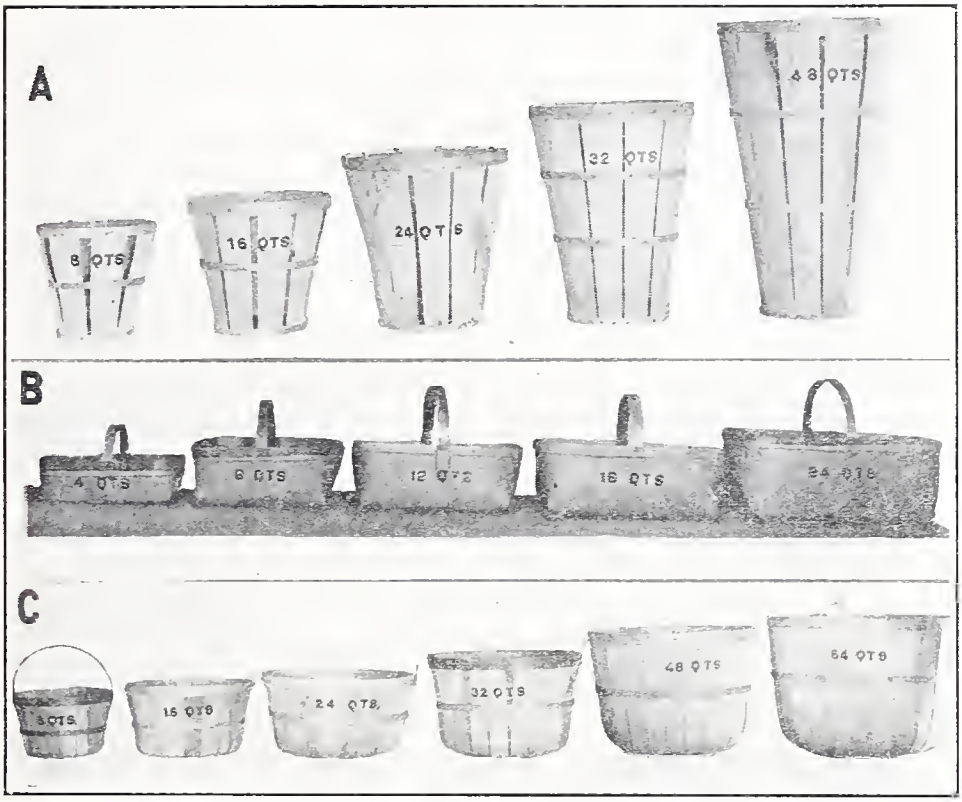


Fig. 11. Proposed Sizes of Standard Containers.
A. Hampers. B. Splint Market baskets. C. Round bottom baskets.

this particular size is not so common but smaller sizes are more popular than the twelve quart. There seems to be a tendency toward the smaller size of package, such as the eight quart, to be used in this district as it makes a most satisfactory size for sale direct to the consumer. One of the problems of the splint basket is the variation in its size. The thinness of material and the demand for a clean package has resulted in the general use of only new baskets.

The market box used in the Philadelphia district is largely a local package which is returnable to the grower for further use. The distribution of this package is rather limited and products which are shipped any distance from Philadelphia are repacked into other containers. The round bottom basket, especially the bushel size, is of increasing importance in quite a few districts. It seems to be the most satisfactory bushel package in use in the state, as the hamper of this capacity is not a handy package to handle.

Standard Packages Most Satisfactory

In the table given below the minimum weight per bushel as required by the present law is given:

Vegetable	Pounds
Beans, dried	60
Beans, castor (shelled)	46
Beets	56
Cabbage	50
Carrots	50
Cucumbers	48
Horseradish	50
Onions	50
Onion sets	28
Parsnips	50
Peas, green (unshelled)	28
Peas, dried	60
Potatoes	60
Potatoes, sweet	54
Rutabagas	60
Spinach	12
Tomatoes	56
Turnips	56

The figures above are an effort to determine a definite weight that can be assumed to fill a bushel measure. Due to variation in variety, size, etc., such minimum weights are not uniformly satisfactory. The tendency in other states seems to be distinctly in the direction of standard sizes of packages for wholesale purposes. Laws have been passed in both Massachusetts and New Jersey in the last few years making it compulsory for products sold in less than package lots to be sold by weight. In this way it is hoped to eliminate the measuring of products by dry measure by substituting sale by actual weight. While most of the business in Pennsylvania is still handled by measure, it would be well for Pennsylvania producers to bear this tendency in mind.

More Careful Grading Needed

The larger growers in general follow good grading methods in the preparation of their products for marketing. Because of closeness to the market it has not been necessary for them to standardize and grade to the same extent as in more distant shipping districts. However, as their product usually comes in direct competition with such outside shipments, it seems likely that they will eventually adopt the grades in use elsewhere.

Among the smaller growers there are two general groups. The first of these includes those who take a reasonable amount of care in the grading of their products. While such men frequently do not use standards as high as those in the strictly commercial districts still their product is sent to market in good condition. Owing to their proximity to market, it is possible for them to modify their grading practices depending on the relative shortage or surplus of particular commodities.

The other group are growers who pay little attention to grades and who usually market their product field run. The interior of the package is frequently found to be considerably lower in quality

than the outside portions. Such grading practices are injuring the reputation of all locally-grown products. If such growers cannot be educated to eliminate such practices, they will eventually be forced out by competition.

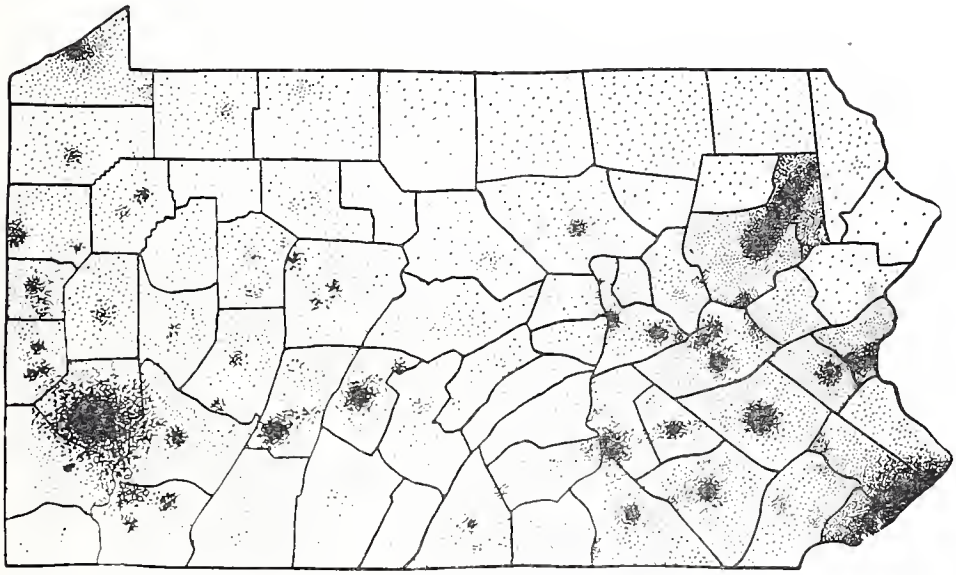


Chart I Showing numerous centers of population which serve as excellent local markets for vegetables.

Transportation Largely By Truck

Inasmuch as most of the vegetables produced in Pennsylvania are sold within a few miles of the place of production, the motor truck has become the most important method of transportation. With the increased construction of hard roads over the entire state it seems likely that the vegetable industry will develop in new districts where conditions are favorable for it. While the use of motor trucks involves some expense, the cost is usually much smaller than the freight from other producing sections. The saving in time is an even more important factor as it insures fresh products ripened naturally. In a few districts products are purchased at the farm by hucksters who make a business of hauling to the city. This is not as common in the case of vegetables, as in the case of eggs and poultry products. In most instances the farmers of the state transport their products in their own wagons or trucks.

In those sections where shipments are made in carlots, transportation facilities seem to be good and such products are not at a disadvantage with competing districts.

VEGETABLE CONSUMPTION INCREASING

The consumption of fruit and vegetables has probably increased more rapidly than any other class of foodstuff during recent years.

There has been a steady increase in the number of cars shipped over the entire country especially in such products as lettuce, tomatoes, celery, etc. Corresponding increases in consumption must be made if the increased production is to be marketed profitably. This can be done in a variety of ways. Much can be done by the growers themselves if they will produce the varieties which are demanded by the consumer, grade them well, put them up in attractive form and market them as efficiently as possible.

Little has been done in Pennsylvania in the question of advertising to increase consumption. There are decided possibilities in this direction, however, and this should be one of the developments of the near future. If Pennsylvania growers will market graded products in attractive form, with satisfactory advertising it is very likely that the frequency of glutted markets can be reduced.

A recent study of the consumer demand for milk conducted at Philadelphia indicates that vegetables are more in demand than any other single class of food. One hundred and seventeen housewives were asked to state their preference with the following results:

Food	Rank	Score
Fresh vegetables	1	311
Meat	2	297
Bread	3	260
Milk	4	222
Fruit	5	145
Potatoes	6	110
Eggs	7	108
Cereals	8	62
Butter and cheese	9	46
Desserts	10	26
Poultry	11	24
Fish	12	15
Salads	13	5
Macaroni	14	3
Canned Vegetables	14	3

A careful study of the food supply of Altoona, in 1923, gave the following figures for the annual per capita consumption of vegetables:

Commodity	Pounds
Asparagus	.07
Beans (green)	4.86
Brussels sprouts	.15
Beets	4.50
Cantaloupe	2.08
Carrots	3.12
Cauliflower	.52
Celery	9.16
Cucumbers	10.80
Cabbage	52.33
Egg plant	.23
Endive	.19
Kale	.10
Lettuce	5.80
Onions	15.44

ASPARAGUS

Asparagus, one of the first vegetables of spring, has brought many dollars into the pockets of growers who have suitable soils and good markets and who are able to satisfy the exacting requirements of the crop as to plant food and general attention. It is one of the vegetables of which the home grown supply is always thought superior to that which is imported, at least when it is well grown and packed, and for this reason growers need to fear less from outside competition. It is also among those crops which may safely be recommended for planting by market gardners, because there is rarely too much of it on the market. On account of its special need for heavy feeding and daily attention, moreover, it does not always thrive on general farms, and this circumstance adds to its just popularity among commercial vegetable growers.

Two Sections Lead in Production

There are but two sections of Pennsylvania where asparagus is grown by many truckers, and of these, only Penn's Manor which has for its shipping point Morrisville in Bucks County is devoted almost exclusively to this crop. In this neighborhood are about ninety growers with upwards of five hundred acres of asparagus, all of which is grown under much the same conditions and is marketed in the same way. The largest planting of mature asparagus in the state, so far as present records show, is located at Morrisville, 90 acres being cultivated.

At North East in Erie County is located a smaller acreage which is associated with a prosperous general trucking and small fruit business. The largest planting in this neighborhood in 1920 was twenty acres, while the total acreage at that time was probably under one hundred.

Near every large city in the state growers with from one-half to two acres of asparagus may be found. At Philadelphia a few of the Bustleton growers operate small acreages. On the bottom lands at Wilkes-Barre some 90 acres were cut in 1924. In Allegheny County the acreage is small but has increased slightly in recent years. York County reported twenty-five growers, with a total acreage of less than ten, no one man having more than one acre. Outside of these districts asparagus planting is very much scattered in Pennsylvania, entire counties seeming to have no asparagus growers whatever. The northern tier of counties, excepting Erie, and all the Appalachian Plateau in west-central Pennsylvania from north to south, is very poorly supplied with home grown asparagus. Since the survey records were taken there has been considerable planting of asparagus in many parts of the state,

and present indications are that the acreage in this crop will probably be gradually increased in Pennsylvania for several years to come. Crops forecasts indicated 1000 acres of asparagus were to be cut in Pennsylvania in 1925.

Distribution Affected by Soils

The location of the two principal producing sections, and in addition the smaller area at Wilkes-Barre, has been determined largely by the presence of favorable soils. The Penn's Manor soil is nearly ideal for commercial asparagus growing. It is usually sandy on the surface, with more or less gravel in places, and the subsoil, from twelve inches to many feet below the surface, is porous gravel. This gravel has a commercial value for concrete construction, a fact which bids fair to drive many of the asparagus growers out of the neighborhood, as large sums are offered for the land by gravel companies. Penn's Manor soil is very early, easily and therefore cheaply worked, and is located near good roads. At North East sandy and gravelly soils also prevail. They are desirable here chiefly to make cultivation easy, since early yields are of less importance than in some other parts of the state.

Wilkes-Barre growers have a river-made soil that is nearly free from stones and is fertile. Though it is easily worked when dry, there is evidence that this soil does not warm up so early in the spring as its texture would lead one to expect, or rather that its behavior is erratic because of the uncertain action of the neighboring river.

Allegheny and York County growers must use heavier soils, and their choice of this crop has been dictated more largely by market demands than by soil conditions. This is true of smaller plantings throughout much of the state.

There seems to be little doubt that small markets that for many years have been nearly self-supporting with respect to all vegetables use less asparagus per capita than do the larger cities. This fact perhaps explains the lack of asparagus planting in several dozen Pennsylvania counties which have only small towns. Part of the state, also, has so short a growing season that imported asparagus can easily secure and hold the market. The northern counties, in which glacial soils of the Volusia and associated series prevail, seem to offer less favorable conditions for asparagus growing than do many of the other sections.

Asparagus does not appear to be a vegetable that has been greatly in demand among the industrial part of the population. Mining towns and steel centers that consume immense amounts of cabbage have used but little asparagus. This is partly explained by the

fact that much of the coal country in Pennsylvania is characterized by rough and stony land that offers slight inducement to asparagus growers. Demand for this vegetable is however increasing in the industrial centers.

Just what effect on the success of asparagus growing is exerted by the variation in length of growing season is hard to determine. It seems clear that two towns with as much as ten weeks' difference in the length of the average growing season must offer radically different conditions for asparagus growing. Although the actual cutting season never occupies as much as 138 days, which is the frost-free period at one point in Pennsylvania, yet a growing season as short as this will certainly reduce the crop by shortening the time of cutting or the time during which the plants can store food for their next crop.

PROFITABLE ASPARAGUS CULTURE

A large number of Pennsylvania growers do not know the name of the variety they grow. This is to be expected, however, because varieties are difficult to distinguish one from another, and it is easy to forget names during the many years that the plantation is in bearing. Records show that Palmetto, Barr Mammoth, Argenteuil, Columbian Mammoth Conover Colossal, and Reading Giant, have been the popular varieties of the past. It is now generally agreed that at least the first five of these are so nearly alike as to be considered the same variety.

In recent years the Washington strains have come into prominence not only because selected for rust resistance but also because developed for desirable market characteristics. Practically all the asparagus recently planted in a commercial way in Pennsylvania is Mary Washington, Martha Washington, or Re-selected Washington.

The desirable characteristics growers now consider in selecting a variety to plant include:

1. Large size stalks.
2. Close head that does not break until shoot has grown quite long.
3. High yield.
4. Early production (unless in section where late development is desirable to escape freezes).

So-called "white" asparagus and "green" asparagus are not varieties but only the products of two methods of culture. Formerly eastern markets desired asparagus of which only the tips were green, the rest of the shoots being white or nearly so. Shoots of this kind may be produced by any variety if the soil is ridged deeply enough over the rows, so that the crowns are not injured

when the cutting knife is forced far down into the soil. Such asparagus is cut when only the tips show above the surface and the shoots are therefore blanched by the earth covering.

"Green" asparagus is now more popular on eastern markets, probably because it has a more distinctive flavor than the bleached type. The stalks are allowed to grow farther out of the soil before being cut, the light thereby turning them green. Green asparagus may be grown on heavier soils than the white type, and careless cutters may do more damage in a plantation of the white "grass."

Many Growers Raise Own Roots

But little home seed saving has been practised among Pennsylvania growers. This has been due largely to the dioecious and hence cross-fertilizing habit of the plant which makes the parentage on the male side uncertain under ordinary field conditions. It would probably be practicable to transplant desirable plants both male and female from field to an isolated breeding plot in the garden so that only known plants would be involved in the parentage of the seeds.

Large planters of better strains of asparagus in Pennsylvania are coming more and more to raise their own plants. By doing this they can be careful of the quality of the seed planted; they can give the plants room enough to develop large size the first year; they may have the plants ready at just the right time; they may select only the best roots for field planting; and the roots cost less when produced at home. The rows are planted from eighteen inches to three feet apart, depending upon the method of cultivating, and the seeds are dropped not less than two or three inches apart in the rows, although six inches will give a more thrifty crown. Planting more closely than two inches not only restricts the size of the crowns but permits such an interlocking of the roots that the crowns are separated with great difficulty. Since the asparagus seed is slow to germinate, a few radish seeds are sown with it to mark the rows so that moisture can be held and weeds kept down by early cultivation. Soil for growing the young plants should be as good as any on the farm, and it should be well fertilized either with manure or with commercial fertilizers.

Plant One-Year-Old Crowns

One year old crowns are now generally preferred to those of greater age, although two year old stock has been more often sold by dealers. If the plants have been well grown and come from vigorous stock they are large enough at one year of age, while at two years they would be so large that too great injury would result from transplanting.

Whether plants are grown at home or are purchased from other growers or dealers, it is good practice to select from the lot only those that have made a thrifty growth and show a few large buds rather than many small ones. Purchased plants, if small, furnish poor material for any kind of selection, because there is no way of telling whether small growth is due to crowding or to hereditary weakness.

When plants are grown at home the crowns are dug either in the fall for storage until spring, or may be dug in the spring. The adoption of the one plan or the other depends partly upon the character of the soil, which may make very early spring work difficult and disagreeable, and partly upon the press of work that may be expected when the ground gets warm enough for plowing and fitting. Stored plants may be sorted during the winter if they have been placed in an accessible place, and the selection may then be given more time and care than is possible in the hurry of early spring.

One Lancaster County asparagus grower reports success in seeding asparagus directly where plants are to remain. The furrow is plowed out as usual, a light coating of manure scattered in the bottom, three or four seeds dropped to a place every three feet in the furrow. Later all but one plant are removed. Rows are four feet apart, making the crowns three by four feet. Furrows are not completely filled until the end of the second year.

Sandy Soils Preferred

It is a fact worth noticing that without known exception centers of commercial asparagus production in the East are characterized by sandy or gravelly soil. Asparagus growers in New Jersey, Delaware, and Maryland, ship much asparagus to southeastern Pennsylvania markets, and almost all this asparagus is grown on sandy land. In Pennsylvania the usefulness of sand and gravel has been recognized by growers at Penn's Manor and North East, and nearly all the plantings of more than five acres in this State are found on sandy soil. These circumstances confirm the belief, which one would gather from the fact that asparagus grows wild most frequently on sandy beaches, that this plant delights in loose and well drained soil.

It is nevertheless true that asparagus has been grown sucessfully on practically all the soils of Pennsylvania, provided that drainage is good. No records are at hand to show that the crop is ever grown, in this state, on muck soils, although this is true in California. The choice of soil in this state seems to be governed less by the needs of the plant than by the desires of the grower for early

growth, easy working of the soil, and freedom from those minor hindrances to growth, such as sharp stones and hard crusts, that do not entirely prohibit growth but do reduce the market value of the product through injury to the shoots.

One of the factors that, years ago, gave a special value to sand for asparagus growing was the practice of hilling the soil very high in order to blanch the stems for the production of "white" asparagus. The light sandy soil could not only be worked more easily, and more quickly after rains, but the great depth of soil covering the crowns must of necessity be easily penetrated by the shoots. It is now claimed by some growers that asparagus shoots growing in sand tend to open their scales and run to branches more quickly than do those that are growing in heavier soil. This may be a serious trouble among growers of green asparagus, especially in the month of June when the weather has become warm and the sunshine hot, and would be particularly undesirable as far as a canning crop is concerned. It is probable that this difficulty may be overcome by using the newer and better strains, the heads of which do not "break" quickly. As long as most of the profits must be made during April and May, sandy soil will always prove most popular for market asparagus.

Condition of Soil Most Important

Since asparagus is a crop that remains in the same ground for many years, it is important that the soil be in good condition when the roots are planted. It has not been the practice to add organic matter to asparagus plantations except through the use of animal manures, and for this reason the preparation of the land has usually involved the planting of green crops a year or for several years before the asparagus is set out. The most common procedure has probably been the growing of a cultivated crop the early part of the preceding season, followed in the late summer with rye or one of the clovers, the green manure resulting being turned under in the spring. Rotted manure may also be used at this time or the manure may be used on the winter cover crop. Commercial fertilizer may be applied to the green crop and some growers apply bone meal or some similar slow acting fertilizer a year before the "grass" is planted.

The older vegetable growers have felt that animal manures are necessary in asparagus growing. Evidence indicates that the manure is needed chiefly for its effect on the physical condition of the soil. Many growers, in these times of high manure prices, have turned to commercial fertilizers as a cheaper source of plant food and are using lesser amounts of animal manures supplemented by

commercial fertilizers; others are trying to grow green manures in the asparagus as a substitute for animal manures in maintaining the organic content of their soils. Certainly animal manure introduces weed seeds and its use is to be avoided on asparagus, if possible, for that reason.

It was formerly recommended that land for asparagus be plowed very deeply and that manure be bedded at the bottom of the plowed area. In commercial plantations, subsoiling is now no longer popular. Asparagus soil should have a surface layer of at least seven inches, preferably eight to ten. With the crowns set nearly at the bottom of this layer, and with heavy fertilization, many good crops may be expected before the roots reach so near the surface as to make further cultivation no longer profitable.

Closer Planting Distances Being Used

The older asparagus plantations were planted with the roots as much as four to six feet apart, and patches were cultivated both ways. This system accounts in part for the age of many of the older successful plantations, since many years passed before the root became large enough to seriously crowd.

The tendency now is to place the rows five to six feet apart with the roots from ten inches to two feet in the row. Cultivation is practiced then in only one direction. Crowding occurs sooner, so that plantations may last only ten instead of twenty years; but with the greater number of roots planted per acre, and heavy feeding, large yields are secured during the early years following planting.

Furrows are plowed out and then further shoveled out by hand to provide about an eight inch depth for the planting of the roots. Deeper planting is sometimes practiced on the light sandy soils. The crowns are set carefully and covered at first with only two or three inches of soil, the furrows being gradually filled level during the first and second seasons. It is especially important not to cover too deeply on the heavier soils until the plants get well established. In Pennsylvania spring planting of asparagus is preferred to fall planting for practical reasons.

Fertilize Heavily in Early Years

Asparagus needs particularly heavy fertilization during the early years just following planting. Heavy feeding at this time encourages vigorous growth of tops, and roots, will advance the time when cutting may begin, and results in larger and better yields in the seasons to follow.

One Erie County asparagus grower applies one-half ton of bone meal per acre in the furrow before planting the roots; after setting, manure is spread over the newly covered rows with a manure spreader. Another man uses a considerable amount of manure and 600 pounds of a 5-8-8 mixture in the furrow. The following spring both growers top dress along the rows with 200 pounds of nitrate of soda and may later use some of the above complete fertilizer as well.

That asparagus growers in Pennsylvania have studied their crop and have adapted their methods of fertilization not only to the needs of the crop but also to the other conditions found on their farms is shown by the following typical methods used.

1. Manure four inches deep every other year, applied the first of July or in fall.
2. Manure 25 tons per acre, applied in summer.
3. Manure 25 tons every other year, applied in early winter.
4. Twenty tons manure, half in spring, half in summer.
5. Ten tons chicken manure in spring.
6. Manure ten to fifteen tons applied in spring, 500 pounds nitrate of soda at end of cutting.
7. Six to eight tons manure in winter, 1000 pounds 4-8-4 fertilizer in summer.
8. No manure; 400 pounds nitrate of soda, 1400 pounds acid phosphate, 200 pounds muriate of potash, applied July 1. This is equivalent to a ton of 3.6-11. 2-4.8 mixture to the acre.
9. Ten tons manure in fall, 1000 pounds 5-8-5 in spring.
10. Eight tons manure in summer, 1000 pounds 5-4-5 in spring.
11. 1000 pounds 4-8-6 in spring, ground fish in summer.
12. One ton 5-8-8 broadcasted at end of cutting season.

In the Philadelphia section, many growers apply 500 to 600 pounds of kainit when the cutting season is half over, as it helps to keep down weeds and is said to make the quality of the crop better. It will be seen at once that in a state with such different practices as these, which represent nearly all the possible combinations of manure with or without fertilizer and several different ideas as to the time of application, no one plan can be said to be ideal for every grower.

The principal factors that have affected the manuring and fertilizing methods in Pennsylvania, as shown by growers' practices and experimental work, appear to be the following:

1. The fact that the marketable part of the plant consists of young shoots that come up in the spring has led many growers to think they can increase current crops by fertilizing or manuring the land in the spring before growth starts. Although the plants may

absorb soluble plant food, especially nitrates, in the spring months, it is doubtful whether the crop of shoots is affected by such absorption. It is believed that only the organic food stored in crowns and roots during the summer and fall months has any influence upon the crop of shoots. This is to be expected since the plants do not produce any foliage during cutting season and since the chlorophyll in leaves and stems is depended upon for the manufacture of complex plant substances from the single plant foods contained in fertilizers. Therefore when nothing interferes, growers like to apply fertilizers at the end of cutting season with the idea of supporting a vigorous growth of foliage, and the consequent storage of much plant food in the roots.

2. The application of animal manures in fall, winter, and early spring is largely due to the convenience and the relatively low cost of the work in these seasons.

3. The exclusive use of manure on certain farms is in some degree a result of the habit of years. Except for their physical effects on soil, animal manures are probably not absolutely necessary for asparagus in Pennsylvania, and green manuring crops may possibly be substituted.

4. The supplementary use of commercial fertilizers is partly due to a realization of the value of soluble plant foods for quick results, the growing scarcity of animal manures, and the wish to avoid weed troubles that follow the use of animal manures. The use of heavy applications of manure every other year instead of small amounts annually also has a connection with weed growth, inasmuch as the heaviest work following the larger application might well be completed during the first season, the second season finding the land fairly well cleaned up.

5. The experience of growers in Pennsylvania seems to show that a thousand or twelve hundred pounds of a complete fertilizer rich in ammonia is sufficient for an acre of asparagus on ordinary soil, though some growers use much heavier applications than this.

6. The need of asparagus for ammonia is shown by the use of mixtures and manures rich in this element and by occasional supplementary application of nitrate of soda.

7. The use of acid phosphate in addition to manure is certainly to be recommended.

8. There is little evidence to show that five per cent of potash would not be sufficient even on the lighter sands and gravels, whether or not manure is used.

9. When asparagus appears as one of many crops on a market garden farm, it is likely to receive much the same fertilization as many of the others receive.

Lime and Salt Occasionally Used

Few Pennsylvania growers use lime regularly for asparagus though Rhode Island experiments indicate that this crop is one of high lime requirement. With the use of less manure it may be expected that more lime will be used.

For many years growers made applications of salt to asparagus to increase yields. The foundation for this practice probably arose from the fact that wild asparagus grows well in sea coast soil washed by the salt water. It is now thought that to a limited extent the sodium contained in salt may take the place of potassium in plant nutrition and that under certain conditions sodium will help liberate potassium from compounds in which it is unavaliable to plants but the amount is probably negligible. Where large amounts of manure are used too, there is probably plenty of potash supplied.

Growers do report that they have had fair success in weed control by applying two tons or more of common salt per acre of asparagus. Such annual weeds as Smartweed and Pigweed are killed by such applications, but the perennial grasses are resistant to salt. It is likely that weeds may be better controlled in other ways than by the use of salt.

Many Methods of Weed Control.

While weeds are a problem wherever they occur, in the asparagus field they are unusually troublesome because the crop stays on the land for many years, and the soil cannot be handled in the same way as with other crops.

Much of the common practice in cultivating asparagus is determined by the idea of weed control more than moisture conservation. In order to loosen the upper soil to permit the shoots to get through more easily, asparagus fields are always either plowed or disked or harrowed in the spring before much growth has started. While the plantation is yet young some growers prefer to plow in spring, as they think the weeds are better controlled by this means. The harrow commonly used is the ordinary wide disk harrow adapted to general farm work, but both the spring tooth and acme are used at times. At Morrisville, however, a special asparagus disk harrow with larger disks and only six of them is frequently used. This harrow is both a hiller and a leveler of hills, according to the way in which the disks are adjusted. Since at Morrisville the ridges are made and torn down several times during a single year, a tool of this sort is nearly indespensable, and the character of the soil, which is very sandy, favors its use. One grower describes his method as follows: In the early spring the

rows are found to be ridged. These ridges are leveled by the use of the special disk harrow, and the spring fertilizer is applied broadcast. Gradually during the season the rows are again hilled. In late fall the hills are torn down again, the fall manure application is given, and the rows ridged again to mark them for working in the spring and to cover such weeds as chickwood. It is pointed out by this grower that the opening of the ridges early in spring helps to bring the sun's heat nearer to the crowns, and thus promote an early start. Other growers think the soil warms more quickly if ridges are left, since the sun's rays strike more nearly at right angles to the surface on the south sides of ridges.

It would seem that winter manuring of the surface would not favor early warming of the soil, since the manure keeps the sun from reaching and warming the soil. It has already been pointed out, however, that the convenience of winter manuring often offsets apparent disadvantages in other directions.

The first working of the land in spring is usually such that all weed growth left on the soil after cultivation ended in the previous summer or fall is well cut up. Frequently the dead tops of the plants have to be cut up at the same time and worked into the soil as is the case with a green manure if such has been used.

About half the Pennsylvania asparagus growers seem to favor level culture of the asparagus field through the year, while the other half practice level culture early in the spring but try to make ridges gradually as a means of controlling weeds. Ridge culture is also practiced in old plantations for another reason, that is, to prevent injury to the crowns, which in old plants are near the surface, and is sometimes done as an emergency measure to protect shoots just coming through from freezing. When strictly level cultivating is used, it is usually necessary to disc the land a few times during the season and immediately after the day's cutting, to keep down the weeds; growers may cultivate once a week with broad tooth cultivators with disc hillers to cover any weeds in the row, or in many cases hand hoes are used. It is questionable whether a field throughly filled with wild grasses of the persistent kinds can be profitably handled. Cultivation is continued until the asparagus shades the ground.

First cuttings of asparagus are made usually in the third year after the crowns are set out. However, with large roots and closer planting, growers are beginning to cut for a week or two the second year; the third year cutting is restricted to about four weeks. Thereafter the cutting season is extended to eight weeks or more, depending on the prices secured, the press of other work, and the condition of the plantation as shown by the growth of shoots.

The number of years during which an asparagus field may be profitably kept depends partly on the care given it, and partly on the depth and spacing of the crowns. With closer planting as now practiced and explained earlier, ten years may be taken as the limit during which first class asparagus is expected.

Asparagus Beetle Only Important Insect

The common asparagus beetle is the only insect regarded as dangerous at present by Pennsylvania growers. The better methods used to keep this pest under control are:

Close cutting during harvesting season.

Application of an arsenical spray or dust after cutting season.

Trap row every thirtieth row, allowed to grow up during cutting season and sprayed with arsenical.

Penning chickens in the asparagus field.

The rust disease is now fairly well taken care of through the planting of only rust resistant varieties such as the Washington types, and giving the asparagus plantation the best of care.

MARKETING ASPARAGUS

Asparagus is grown for local canning in Erie County. The "grass" is cut green and sold by contract for a price running usually 14 cents per pound for five and one-half inch stock, fieldrun, without packages. Either splint baskets or fruit trays are used for handling the shoots. One grower in this section has the asparagus put into splint baskets in the field, hauled to packing house, and there packed into a box 5½ inches deep, three feet long and 18 inches wide. This box has one side hinged, which is left open when packing. The box is placed at an angle on edge to keep the "grass" in place while packing. The stalks are placed in the box tips down and when filled the side is closed down to hold the "grass" firm. Then the butts are cut off even with the top of the box. The stalks are placed in crates with butts to the end.

Another farmer who grows asparagus for the canner, packs the stalks tip down in small boxes which are just large enough to slip into the fruit tray. These boxes are five and one-half inches deep and the butts of the stalks are trimmed off even with the tops of the boxes.

Green Type Asparagus Most Popular

The tendency of the consuming public during recent years has been toward green asparagus and away from white or blanched stalks. This change in demand has had its effect on the eastern Pennsylvania markets, in that the local grown or green "grass" is preferred to the white product of New Jersey. The growing methods are also being changed in many sections to meet the new requirements.

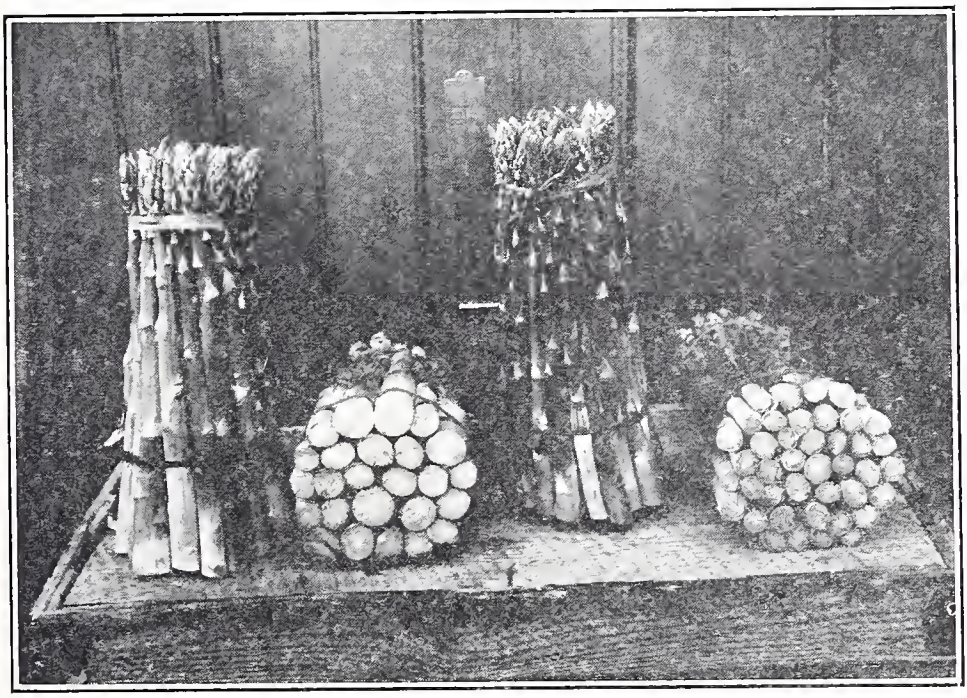


Fig. 12. Eleven-inch asparagus bunched and ready for crating. Grown in Penn's Manor section.

For cutting the asparagus shoots the more progressive growers use the chisel-like Asparagus Knife with either a single slanting cutting edge or with the cutting edge shaped like a V. Cutting the shoot three or four inches below the surface of the soil gives the required length without having to wait for it to grow sufficiently tall above ground. Each extra hour that the shoot is above the surface is only added exposure to the beetles. In other sections of the state just a sharp carving knife, or in some cases a pocket knife is used, though this latter does not make a very clean cut. Some growers especially in small patches break off the "grass." To do this perfectly requires a dexterity not easily acquired. Some cut at a 45 degree angle others cut with downward stroke to avoid injury to shoots not yet showing.

In most commercial beds the stalks when cut are placed in some sort of basket or container, which is collected by a wagon

or truck and brought to a sorting and packing shed. In one instance near Scranton the cutting is done by Polish women who place the stalks in burlap sacks fastened to their waists and bring each sack full to the packing bench under some trees at the edge of the bed. This is the only instance observed where the bunching and tying was done in the field. It is also rare to find the cutters stopping to walk in with a basket or sack full of stalks. In the larger commercial enterprises it pays to have some one to take the containers from the field to the packing shed.

Various Containers Are Used

There is usually some attempt made at grading asparagus, depending on the grower. Pennsylvania growers use almost any kind of package, but mostly an orange crate with 24 bunches to a side or a market box with 40 to 50 bunches. Some progressive growers use a special flat crate that holds 24 bunches in a single layer. Erie growers pack 24 half pound bunches in a 12 quart climax basket with layers of damp moss in the bottom and ends.

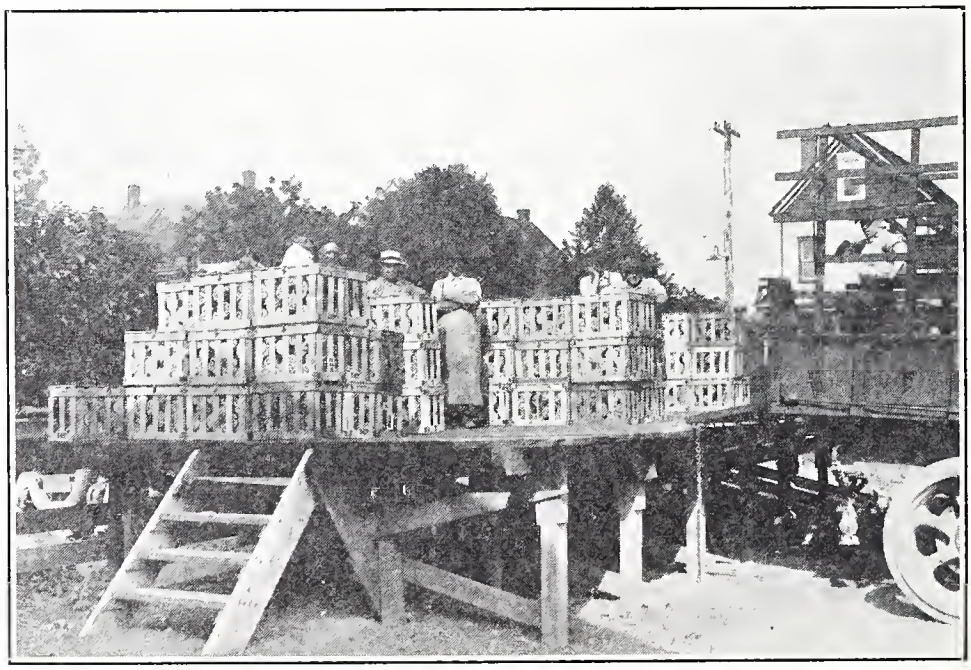


Fig. 13. Loading asparagus at Morrisville, Bucks County, for shipment by truck to Newark and New York.

The bunches range in size from a half pound to 2½ pounds depending on the section where grown and the season. Some growers use half pound bunches early in the season and pound bunches when the crop becomes more plentiful and keep the price uniform. In most sections the bunching is done by hand, with rubber bands

used to hold the stalks together. Some growers use a regular asparagus buncher and add attractiveness to the product by tying with colored tape.

CABBAGE

Cabbage ranks with the tomato as one of the most popular Pennsylvania grown vegetables. It is found in all parts of the state, thriving in localities not so favorable for the tomato. Its composition places it among the substantial foods, so that it is particularly well liked in those counties where coal mining and the steel industries furnish heavy manual labor for thousands of workers of the unskilled and semi-skilled types. Here the late cabbage crop and its chief product, sauerkraut, are most popular but the early cabbage crop is relished everywhere. Cabbage is universally recognized as one of the indispensable vegetables of the farm garden.

The rank of Pennsylvania among states in acreage of late cabbage in 1922 was 7th with 2800 acres. Wisconsin led with 16,575 acres and New York was 2nd with 24,895 acres.

Cabbage Growing Widely Distributed

Cabbage is grown by over 65 per cent of the market gardeners of Pennsylvania. No other single vegetable except the tomato has so wide a distribution. Hardiness with respect to frost makes cabbage adapted to the coldest as well as the warmest parts of the state, and it is this characteristic which makes the crop such a popular one with gardeners who try for the early high prices without the frost risks attendant upon the culture of early tomatoes.

Except in the localities that specialize in late cabbage for carlot shipping the early varieties are grown extensively, at least for home use, in every county of the state. In the Philadelphia section, the acreage of early varieties is slightly greater than that of late varieties, a condition not often found where both kinds are grown. In York County, in the sandy soils near Montandon, and on the river bottoms near Wilkes-Barre early cabbages are generally planted. In Allegheny County early cabbage is planted in about equal acreage with late while in Erie County outside of the Waterford district early varieties are more popular than late ones. In many of the mining sections general farmers plant from one-half to two acres of early cabbage for local markets. In general, it may be said that except where imported cabbage is a factor of importance in the market, early varieties are more widely grown for sale to native born people while late cabbage is most profitably planted for disposal to foreign born people or those of recent foreign descent, in the mining and manufacturing centers.

There are only two well defined sections devoted to late cabbage growing in Pennsylvania. One of these is located in Northern Indiana and southern Jefferson Counties with its middle point about at Marion Center. Farm acreages for cabbage here range from one to ten acres. The country is very hilly, except on one side of Punxsutawney and this fact tends to reduce the acreage per farm. Much of the cabbage grown here is sold in the mining towns. In good seasons however, many carloads are shipped from this section, and an association of growers has been formed to market the crop.

The other principal late cabbage section is in south central Erie County with Waterford as its shipping point. The crop here is grown as a side line to dairying. The country is rolling but large fields can easily be prepared for cabbage. Recurring seasons of low returns have probably deterred growers from enlarging their acreages, no farm reporting in 1920 having more than 12 acres. All the Waterford cabbage is shipped away from the section.

Hardiness of late crop cabbage commends it to general farmers since the crop follows corn well in rotation of farm harvests. Cabbage is also popular with dairy and poultry farmers since if the crop does not sell for a profitable price, it may be used as feed for the dairy cows or the chickens. In the Wilkes-Barre district a great many of the general farmers plant from four to five acres of late cabbage.

Cabbage prefers cool weather and moist soil. There is little summer cabbage grown in Pennsylvania except in the summer resort sections as Pike County though the market demand is good in many parts of the state.

SUCCESSFUL CABBAGE CULTURE

Cabbage varieties in Pennsylvania are chosen partly to fit the growers conditions but largely to suit the markets served or the seasons when the crop is grown. The following table shows a number of the more important cabbage growing counties with the number of large growers in each who reported the varieties used.

The tabulation shows that Copenhagen Market is the most popular early variety in the Western end of the state while in the Eastern Counties, particularly the Southeastern quarter the Jersey Wakefield takes a conspicuous lead. Here Wakefield popularity is probably brought about by the heavy early shipment of this type cabbage into Southeastern Pennsylvania from the Southern states, the consumers thus getting to know and ask for this variety. A prominent market gardener of Luzerne County states, "Habit is a pronounced factor in the lives of most of us. The old time market gardeners in the eastern part of the country sent to England for their vegetable seed. Early

York, a pointed cabbage was very popular with them. The people near the Atlantic Coast became used to that type of cabbage. Early Jersey Wakefield was a selection of Early York, having good quality and the size head about right for slaw or salad." The market gardeners of Luzerne County all grow Wakefield for early market while the farm truckers of that county put most of their acreage in Copenhagen Market.

Table 3.

District and County	Early Jersey Wakefield	Copen-hagen Market	Glory	Danish Ballhead	Flat Dutch	Houser	Savoy
WESTERN							
Allegheny	11	24	10	17	1	0	0
Cambria	0	10	7	15	0	0	0
Erie	2	16	0	5	1	0	0
Blair	8	10	2	12	1	1	0
EASTERN							
Delaware	20	2	0	2	0	0	1
Dauphin	13	1	0	15	0	3	6
Lancaster	18	2	0	13	1	4	0
Lebanon	12	2	1	7	14	2	0
Northumberland	15	1	2	21	1	0	0
Philadelphia	26	2	0	0	0	0	17
York	44	1	1	28	1	5	0

It is probable that the Western Pennsylvania people will buy a larger headed cabbage than those of the eastern sections and therefore like to buy Copenhagen. The grower prefers Copenhagen to Wakefield since on the average a greater weight yield is produced. The former also does not burst as quickly after reaching market size as does Wakefield. On the eastern markets a 2½ to 3 pound head is the preferred size for early cabbage.

Golden Acre is Favored For Early Use

Golden Acre, a variety that reaches market size ahead of both Copenhagen and Jersey Wakefield is receiving extensive trial by Pennsylvania growers. It is favored for the fact that the plants produce extremely early, solid heads, maturing uniformly but the crop will not hold long without bursting. All Head Early is one of the more popular early sorts and the Winningstadt, a pointed head type, is well known in the eastern counties as a second early variety.

The midseason varieties are few, Succession and Glory being grown to some extent. The latter is also grown for late sales along with

varieties of the Danish type. Glory is usually more productive and of better table quality than Danish Ball Head but does not keep so well.

Except in two counties the Danish Ballhead type is most popular as a late variety. Lebanon County has a leaning toward Flat Dutch, while little but Savoy is grown in the fall in the sections near Philadelphia. In the Indiana, Jefferson, and the Erie County late cabbage sections Danish Ballhead is almost the only kind planted. The kraut makers desire a large firm head that will make long shreds.

The Houser variety originated near Harrisburg and is therefore best known to growers in Dauphin and adjacent counties. Where a small headed cabbage is desired for sales in the fall. Copenhagen market is planted for a late crop or plants of a larger headed variety may be planted close together. Red cabbage which used to be popular in some parts of Pennsylvania especially with people of German descent, has decreased greatly in demand the last few years.

Seed Not Generally Grown in State

With the exception of a dozen men, all cabbage growers who reported on their sources of seed were buying from Commercial Seed Houses. Early cabbage seed is produced in Pennsylvania by a grower in the Wilkes-Barre district who has placed on the market seed of an excellent strain of Jersey Wakefield developed by him. Late cabbage seed is grown to some extent, particularly in Erie County but the growing appears often to be accidental, the seeds being taken from volunteer stalks that grew out of old storage pits.

One of the main difficulties confronting the cabbage seed grower in this state is that of holding cabbage successfully in storage through the irregular temperatures of our unreliable winters. Half grown heads keep better than mature heads, and for this reason reliance must be placed upon the uniformity of the stock seed planted since it is not easy to select intelligently from half developed heads the varietal type desired.

Growers recognize the need of good strains of cabbage seed, since the strain affects not only yield, time of development, and uniformity, but certain defects may show up that are due mainly to heredity, as:

(1). Early bursting of heads. This fault may also be due to the variety used and to seasonal conditions.

(2). Rosetted plants that do not form heads or at best develop small late heads.

(3). Leafy heads that do not become solid.

A defect of Ballhead cabbage intended for storage is not commonly recognized by growers. It is the manner of folding of the leaves over the tops of the heads. The ideal type shows not more than 2 leaves on top, one of them covering at least two thirds of the top.

These heads keep better in storage and are more solid than poor heads that show up to six or more leaves on the upper side of the head.

All the strain defects mentioned above may be eliminated by careful selection of seed. Due to the difficulty of growing cabbage seed on the home farm, effort may perhaps be better spent in encouraging the commercial seedsman to procure and maintain superior strains of cabbage.

Methods of Plant Growing

Plants for the early crops are almost always started indoors although some growers import Southern grown plants. Two main methods are used in Pennsylvania to secure earliest and hardiest plants. In the colder counties and on the heavier soils the plants are grown from seed sown in hotbeds or greenhouses in January or February. The second method is used only in several of the southeastern counties and on the warm sandy soils along the Susquehanna River, especially at points in Northumberland County. Here the seeds are sown in the fall in cold frames, early enough so that the roots become well established before freezing weather. They are held over in the frames and set out as soon as the field can be made ready in the spring. Early Jersey Wakefield is the principal variety grown in this way. Field planting of early cabbage takes place from late March to early May in Pennsylvania.

At Montandon several growers sow cabbage seed directly in the field in the spring and thin to the proper distance. The sandy, quick warming soil in the district favors this plan. It is doubtful whether cabbage can be produced as early by this method as from transplanted plants.

Plants for late cabbage are grown from field-sown or frame-sown seed. The latter is preferred by some growers since the frames may be screened to exclude the cabbage maggot fly from the seedlings. Seeding is generally done from May 1 to June 1 so the plants are ready for field setting from June 10 to July 1. One careful grower has used the same quarter acre piece of ground for a seed bed for a number of years. It receives annually 150 pounds of a by-product lime, 50 pounds nitrate of soda, 50 pounds bone meal, and 100 pounds acid phosphate. After the cabbage plants are removed, buckwheat is sown and this grower believes that the buckwheat works with the lime in keeping club root out of the soil. This quarter acre bed in 1921 produced cabbage plants worth $700.

There is a clearly defined tendency toward the buying of cabbage plants from commercial plant growers. This is desirable to some extent since the plant specialist may have better equipment for the purpose than the average grower. However the former should improve the quality of the plants offered by using only the most reliable seeds.

Small Acreage Planted Per Farm

Although cabbage is grown on a great many Pennsylvania farms and is the only marketed vegetable on a large proportion of these, the actual planting on the average farm is small. In whole counties no farm will have more than an acre of cabbage while half acre and quarter acre patches are very common. The factors mentioned below have fixed acreage in past years in this state and are likely to influence the planting every year.

Fig. 14. Cabbage plants grown in small flats for the retail trade.

1. The method of disposing of the crop. Retail selling restricts the amount to be sold within fairly definite limits. When selling is done on a retail farmers market, the amount of cabbage offered usually bears a rather fixed ratio to the number of other crops that are commonly handled by a grower on such a market. When wholesale selling is practiced the grower is more likely to change his cabbage acreage suddenly since he is not so well able to judge the probable demand.

2. The possibility of shipping cabbage to distant markets. A decision must often be made between a small planting that can be marketed locally and an acreage that will permit shipment in large and therefore economic quantity.

3. A thoughtful grower may be able to forecast heavy or light planting in his own locality or in other sections which influence his market, but weather conditions may render his forecasts valueless.

4. Condition of business in market centers. Unemployment causes greater production in home gardens and lower purchasing power of the consumers. Business prosperity may seem to justify heavy plant-

ing of vegetables but at the same time increase the cost of production through high wages for farm labor.

5. Character of the population to be served. Cabbage is much more popular with some classes than others. Where sauerkraut is universally used, large amounts of cabbage may be disposed of at rather low marketing costs.

6. On the general farm competition for labor between cabbage and other crops must be kept in mind in order that no part of the farm business will suffer at critical periods.

7. It must be possible to provide the labor required to handle the cabbage crop at maturity, so that no loss from slow harvesting may result.

8. The possibility of using the by-products, as poorly formed heads and trimmings for stock feed is always worth investigation.

9. Profits on late cabbage for shipment more often depend solely on economy of production than is the case with early cabbage. The former may be produced on a large acreage in rather remote sections where labor is cheap, land plentiful and suitable, and where manure for fertilization is available.

Cabbage a Heavy Feeder

Early and second-early cabbage is produced on many different types of soils throughout the state. As is to be expected the earliest crops are generally grown on the sandier soils. Since late cabbage is set out in the dry, hot months and must make much of its growth in September, a month that normally has light rainfall, the crop grown at this season is commonly planted in the heavier soils.

The cabbage plant is a heavy feeder, particularly of nitrogen and phosphorus, and must grow rapidly if earliness, high quality, and large yields are to be secured. These qualities have influenced the fertilization of the crop in Pennsylvania and make the late crop popular on dairy farms where manure alone or manure and acid phosphate may be depended upon to produce a good yield. On the smaller farms and market gardens, cabbage almost always gets a generous allowance of animal manure; applications of 25 to 40 tons being not uncommon, but 10 tons being near the average. Where low amounts are used the cabbage is usually planted on sod land. Both low grade and high grade commercial fertilizer mixtures are used, a 2-8-2 having been quite popular at a rate of 400 pounds per acre. A higher grade complete fertilizer proves more economical in the long run especially for early cabbage. Acid phosphate and manure is a combination often used.

On the larger market gardens in Philadelphia County, hog and horse manure and night soil are extensively used. Much of the hog manure is produced on the home farms while the cabbage wastes contribute something to the food of these animals. In Philadelphia, Wilkes-

Barre and other intensive gardening sections, such high grade commercial mixtures as a 4-8-4 or 4-8-6, 1200 lbs. per acre, are also used; the carriers of more potash being used on the sandy soils. A common practice is also to give a pinch of nitrate of soda to both early and late cabbage plants ten days to two weeks after planting.

Commercial Fertilizer Popular

Scarcity of manure in Allegheny County has turned growers toward the use of less manure and more commercial fertilizer. A high grade mixture is broadcasted and late cabbage is topdressed with nitrate of soda. In Blair County a popular treatment for cabbage has been 7 to 10 tons of manure, 600 pounds of a high grade fertilizer, and often a top dressing of 100 to 300 pounds of nitrate of soda per acre. Dauphin County growers have reported that they depend largely on ten tons of manure supplemented with 200 to 400 pounds of acid phosphate for their cabbage. Out of 20 Delaware County growers, 12 used manure alone, much of it hog manure; in Lancaster County, of 19 growers, 9 used manure alone, 5 both manure and complete fertilizer, 4 manure and acid phosphate, and one commercial fertilizer alone. In Indiana County nitrate of soda is occasionally used in the water in the transplanting machine. Cabbage here follows a sod or well-fertilized corn or potato crop and thus receives the residual effect from these crops.

In Erie County the late cabbage is fertilized with 300 to 800 pounds per acre of a low grade mixture relatively rich in phosphoric acid as a 2-8-2 or 2-10-2, and in addition 12 to 18 tons animal manure. Corn and potatoes are often included in the rotation with cabbage and receive much the same fertilization.

The most elaborate scheme of fertilization practiced by any Pennsylvania grower who reported his method was on a farm near Punxsutawney. In 1921 the cabbage crop was planted after a sod, this being the preferred place for cabbage in the rotation. Twelve tons of manure per acre were applied to the sod before plowing; twelve tons more were disked into the soil after plowing; on each acre 1000 pounds of acid phosphate and 100 pounds of nitrate of soda were spread; and finally, nitrate of soda was used in the water of the transplanting machine at the rate of three quarts to fifty gallons of water. A practice of this kind offers a remarkable contrast to that of growers who rely on manure applications as low as five tons to the acre, or perhaps two hundred pounds of acid phosphate per acre in connection with a sod.

Experimental Results Should Be Noted

Among the experimental results with cabbage fertilizers that should be noted in connection with growers practices are:

Phosphoric acid appears to be the most important single fertilizer element for cabbage, with nitrogen in second place; while potash may show little effect except in sandy or muck soils, especially when large applications of manure are made.

It is entirely possible on many soils to greatly reduce the amounts of manure used for cabbage by increasing the commercial fertilizer used. This is true of early, summer, and fall crops.

The use of manure alone for early cabbage in Pennsylvania is not wise since the plant food does not become available soon enough to give the earliest and greatest yields.

While late cabbage on well manured land can be grown with acid phosphate alone, there is evidence that the use of some form of soluble nitrogen will benefit the crop.

Lime Applied Regularly

Cabbage is listed by investigators as one of the vegetable crops that require a limed soil. In Pennsylvania records show that in recent years lime has been fairly regularly used on land intended for cabbage. Lime may be applied somewhere in the rotation which includes cabbage rather than directly to the cabbage crop. For example near Waterford in Erie County small applications as 1000 pounds ground limestone are made chiefly to improve the clover stand in the oats year of the rotation or to help the corn crop. When the lime is applied to the corn, it may show some effect in the cabbage the following year, but it can hardly be expected that lime applied to the oats and young clover will be of any direct advantage to the cabbage crop following three years or more later, other than the stimulation of clover growth, and the consequently greater amount of organic matter added to the soil.

Regular Rotations Used on Truck Farms

No definite rotations including cabbage are used on the market garden farms of Pennsylvania. Cabbage is seldom planted year after year on the same ground however due to prevalence of diseases as club root and yellows that are known to remain in the soil year after year.

On the truck and general farms, cabbage occupies much the same place as corn. Both these crops get manure and often commercial fertilizer, and they interfere little with the regular farm rotation. Usually cabbage follows sod, or corn, potatoes, or other cultivated crops.

In Erie County a common rotation on many dairy farms consists of grass, corn, cabbage, oats. Sometimes the grass is topdressed with manure to increase the yield of hay; the corn almost always gets manure, up to 15 tons per acre, and sometimes several hundred

pounds of acid phosphate or low grade mixture; the cabbage gets manure and often fertilizer; the oats may receive a light lime application and several hundred pounds of phosphate fertilizer. In such a rotation the cabbage crop gets plenty of organic matter and perhaps needs little additional plant food except phosphoric acid. In Luzerne County, in a rotation of clover sod, cabbage or cauliflower, potatoes, oats, and clover, the cabbage will probably get heavy applications of manure and acid phosphate.

Planting Distances Vary

Planting distances for cabbage in Pennsylvania vary according to 1. Size of variety. 2. Size of head desired. 3. Method of cultivation practiced. 4. Fertility of soil used.

Small heads under five pounds are in greatest demand in Pennsylvania in general, for family table use, and especially when prices are high; planting distances and varities are selected accordingly. Late cabbage to be sold either for kraut making or in bulk for any other purpose need not usually be restricted as to size of head. This is true also to a great extent of cabbage for hotel or restaurant trade.

Average Yields are Low

As shown by the crop statistics, the average yield of cabbage in Pennsylvania is low, reaching but five tons per acre in 1923, though the average in 1920 was 10.3 tons per acre and in 1922 seven tons. Average yields, however, are rarely profitable and are usually greatly exceeded by progressive growers in favorable seasons. Yields of 10 to 15 tons should be expected from a good strain of early cabbage, well grown. In 1924 a Luzerne County gardner produced 28 tons per acre of late cabbage; the same season, a grower in Monroe County secured 32 tons per acre. In both cases a fine strain of Danish Ballhead was used.

Is Late Cabbage Profitable?

No figures on the return to Pennsylvania growers from the late cabbage crop are available. The question of whether or not this vegetable is a profitable one depends to a great extent upon the local markets for which the cabbage is grown, and how economically the individual farmer is able to produce late cabbage. Figures recently published by Cornell University on returns realized from this crop may be largely applicable to Pennsylvania conditions and are given herewith.

Table 3

COST OF GROWING LATE CABBAGE IN NEW YORK

	1921	1922	1923
Number of farms	13	8	4
Acres per farm in cabbage	3.5	5.0	3.7
Tons per acre yield	6.9	6.3	4.4
Hours human labor per acre	117.8	69.3	102.6
Hours horse labor per acre	86.5	63.5	53.7
Cost fertilizer and lime per acre	$7.89	$8.05	$1.82
Cost manure per acre	9.18	7.50	11.33
Total cost per acre	115.88	74.58	73.16
Cost per ton	16.00	11.61	15.36
Market value per ton	26.11	5.85	11.24
Profit or loss per acre	69.45 Pro.	36.23 Loss	18.22 Loss
Return per hour of human labor	1.00 Pro.	.16 Loss	.11 Pro.

Insects and Diseases are Plentiful

The usual methods used by Pennsylvania growers for the control of insects and diseases of cabbage follow:

1. Clean culture, crop rotation, destruction of crop refuse, rogueing of diseased plants, for general control of insects and diseases.
2. Heavy liming of soil, 40 pounds air slaked lime per square rod, for club root.
3. Use of resistant mid-season and late varieties to eliminate yellows.
4. Seed treatment with corossive sublimate. For control of seed borne diseases.
5. Planting of healthy plants uninfected with club root or yellows as far as it is possible to detect these troubles.
6. Poison bran bait for cutworms and hydrated lime for slugs.
7. Growing of late cabbage in screened frames, and treatment of both early and late plants in field with corrosive sublimate solution for control of cabbage maggot.
8. Spray or dust with arsenate of lead or paris green for cabbage worms and loopers; and with nicotine spray or dust for lice.

CABBAGE NOT GENERALLY STORED

Although cabbage is kept during part of the winter on a large number of Pennsylvania farms few commercial cabbage growers make a general practice of storing this crop. In the Indiana-Jefferson Counties section cabbage is rarely held for winter selling, though one or two growers are provided with excellent facilities for storing both cabbage and potatoes.

In Erie County such cabbage as is not sold in the fall is likely to be piled in long windrows near the barn, and covered with straw and earth. Small pits or covered conical heaps are used throughout the state for cabbage storage on a small scale. Trenches with covering of boards, and straw, similar to celery storage have been used with success. These types of storage are satisfactory only in winters of

steadily cool weather, and are likely to be more generally so in the northern counties and at the higher altitudes.

Fig. 15. Seed cabbage stored for the winter.

Early cabbage is seldom stored in Pennsylvania. The growers generally attempt to bring their cabbage on the market as early and as rapidly as possible, and only a few try for the second early and midseason market though there is demand for cabbage at this time in some parts of the state. Where the midseason market is catered to, summer varieties or successions of early varieties are planted. An occasional grower places early cabbage in cold storage, where such is available in a nearby town, to hold it a few days for a rise in price or demand.

The barrel is the common package used for both early and late cabbage in Pennsylvania, but 100 pound crates and various packages in use for other vegetables on certain markets are also employed for cabbage marketing. No grading is usually practiced other than the removal of damaged or soft heads. Grading as to size is accomplished through the growing of certain varieties or the regulation of the planting distance.

Shipments of carlots of cabbage into Philadelphia and Pittsburgh markets in 1923 and 1924 are shown on the following page.

PHILADELPHIA

State	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	1924	1923
Ala.					26	1							27	6
Calif.				10	2								12	18
Del.													—	1
Iowa													—	9
Impts.		1											1	5
Fla.	51	82	132	120	9							4	398	178
Miss.					2								2	—
Md.						54	17						71	47
N. C.					1	1							2	7
N. Y.	154	108	82	18				1	108	177	213	203	1,064	1,158
N. J.						1	6	1					8	7
Ohio							9	2					11	13
Pa.										3	2		5	4
S. C.	23			1	116								140	405
Tex.			49	70	54	4							177	6
UNKNOWN										1			1	—
Va.					71	208	8	9	1				297	363
W. Va.								1					1	1
Wis.														1
1924	228	191	263	219	281	269	40	14	109	181	215	207	2,217	
1923	190	226	229	227	327	250	30	37	108	188	255	187		2,237

PITTSBURGH

State	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	1924	1923
Ala.					21	5							26	131
Calif.														6
Colo.														3
Fla.	4	15	4	5	1								29	14
Ga.						1							1	4
Ind.											1		1	
Iowa								5					5	6
Ky.						1	3						4	
La.					1								1	8
Md.	1					13	3						17	4
Mich.										1			1	9
Minn.								1	1				2	1
Miss.					21	18							39	114
N. Y.	87	67	33	6				3	41	84	66	45	432	392
N. C.	1												1	6
Ohio						17	159	21	1	1	2		201	166
Penna.	8	11	11						1	15	19	23	88	120
S. C.		1			1	1							3	86
Tenn.						10	1						11	6
Tex.	1		70	111	77	6							265	41
Va.	9	2			5	24		1	3		2	5	51	93
W. Va.						2	2						4	10
Wis.			2										2	49
Impts.														3
Unknown		4			2		1						7	2
1924	111	100	120	122	129	98	169	31	47	101	90	73	1191	
1923	85	82	122	141	213	154	133	15	28	100	111	80		1274

CELERY

Celery is a vegetable of much value because of its contents of calcium and phosphorus and because of its refreshing flavor it is becoming more popular season after season. As an appetizer, a cooked vegetable, a flavoring for soups and stews and a salad, it is used through the greater part of the year. Dried celery leaves and old or poorly germinating celery seed are also used in flavoring.

Pennsylvania for several years has been ranking eighth among the states in commercial celery acreage, California ranking first and Michigan second. The area devoted to this crop has been recently increasing due to the demand for the home grown product. In 1920 less than 200 acres of celery were harvested in Pennsylvania. In 1924 over 300 acres were planted in the Philadelphia section alone, though a considerable amount of this was not harvested due to the disastrous early freeze.

Distribution in Pennsylvania

Much the greater part of Pennsylvania grown celery is planted in the eastern half of the state. Of the counties that lead in celery growing, Bucks, Philadelphia, Delaware, Luzerne, and Tioga have the highest acreage, while York is well represented with respect to the number of growers. Bucks has what is probably the largest acreage under one management, 100 acres having been planted on one corporation farm in that county in 1924. In Tioga County the number of growers is not large, but the individual acreage is above the average, the largest single planting being 48 acres. All of the southeastern counties contain numerous celery fields and few are located in the mountain counties. Throughout the western half of the state there are not many extensive celery growers; probably due largely to less favorable soil conditions.

In the extreme southeastern counties, notably Delaware, Philadelphia and Bucks, the nearness of a large city, the relative freedom from competition during the season when the varieties grown there are marketed, and to a less extent, favorable soil condition, have led to heavy planting. The Philadelphia market is well supplied from New Jersey and Delaware with many other truck crops, but to a much less extent with celery, while the Tioga County and New York early celery precedes in season the bulk of that locally grown.

The soils in the Philadelphia district are not unusually well adapted to the celery crop, but the market gardens there have been heavily manured in past years for other similar crops, and this has favored celery culture.

It is said that the cities in the Wyoming Valley in Luzerne County are more nearly self supporting with regard to celery than any of the other cities of the state. This is due to the presence in the valley of a thriving market gardening industry, located near favorable markets and on river bottom soils which although not of the sorts that are usually associated with celery growing on a large commercial scale, are level, free from stones, and have been made rich by heavy manuring. As at Philadelphia, moreover, the other crops grown on these bottom soils are of the kind that fit in well with celery culture, since

they require much the same treatment as to manuring and fertilizing. In Luzerne County 150 acres were planted to celery during the past season.

In Wayne County, soils and markets are chiefly responsible for the growing of celery on a fairly large scale. That part of Wayne County where celery is grown lies close to the border of Lackawanna County, with Scranton within easy reach and many other smaller mining centers as potential markets. The soils, moreover, are of a muck nature, and these are favorable to this crop. Tioga County is the one district in the state where celery is grown on a commercial scale for shipment, 200 cars being shipped from Wellsboro Junction annually. In Tioga County excellent muck soil is used for the crop. The chief market for this district is Philadelphia. Of the factors that affect celery growing at Philadelphia and Wilkes-Barre, only one, soil, is of importance in Tioga County.

In 1920 about 50 per cent of the market gardners of York County were growing celery, and with the exception of one man who had five acres, the average planting was under one-half acre. The York County growers do a retail business for the most part, and celery is probably grown on many of the farms as a means of holding trade.

The large area of muck soil in Crawford County, on part of which onions are grown on a commercial scale, is not utilized to any extent for celery growing. Throughout the glaciated counties of the state, particularly those of the northeastern part, small areas of muck soil occur which undoubtedly may in the future become useful for celery culture. The northern part of the state, therefore, has the best natural celery soils, but as the experience of Philadelphia and York County growers plainly shows, a great many other soils that occur more generally in the state can be made to produce good celery when market demands are sufficient to encourage planting.

IMPROVED CULTURAL PRACTICES FOR CELERY

The following tabulation furnishes a fairly reliable guide to the celery varieties used in this state, the numbers representing the number of truckers and market gardners, that, according to the survey records, planted each variety in 1920.

Easy Blanching	84
Golden Self Blanching	61
Giant Pascal	15
White Plume	14
Winter King	14
Winter Queen	8
Columbia	5
Emperor or Fordhook	4
Pride of the Market	4
Golden Heart	3
Houser	2

For some of the more important counties in celery production the varieties were as follows:

Philadelphia County

Golden Self Blanching	19
Easy Blanching	23
Winter King	2

Delaware County

Golden Self Blanching	1
Easy Blanching	13
Winter King	4
Pride of the Market	4
White Plume	2
Golden Heart	1

York County

Golden Self Blanching	7
Easy Blanching	17
Columbia	4
White Plume	2

Short season or easy blanching varieties are the most popular types in Pennsylvania as evidenced by the fact that either Golden Self Blanching or Easy Blanching lead in all sections and all the large acreages too are planted in one of these two sorts. It is largely because of the fact that these quickly maturing kinds are hard to hold through the winter in ordinary storage that few Pennsylvania growers attempt to keep celery for market long after the first of the year.

In recent years there had been a decided swing away from Golden Self Blanching toward the Easy Blanching type. This was due largely to weaknesses of the former variety, especially susceptibility to blight and crown rot, but also to the superiority of Easy Blanching as to quality and the fact that it could be held with less loss in field storage. The development of strains of Golden celery such as Golden Plume that are resistant to crown rot as well as being high yielding and of fine appearance, have swung the tide away from Easy Blanching toward these yellow sorts again. Especially is this true in the Philadelphia section where many of the growers favor the Golden Plume type. Here the market gardeners wish to fit their type celery with that imported at other periods of the season from California and Florida, since the general demand for yellow celery is influenced by this shipped in stock.

On the other hand the gardeners of the Wilkes-Barre section have been producing Easy Blanching almost to the exclusion of all other varieties, though several of them are now growing Golden Plume. On that market the growers come in closer contact with their customers and can better push this greener type from the standpoint of quality than could the Philadelphia market gardeners.

The muck sections of Tioga County grow only the Golden types. As a rule the celery produced here is not as fine in quality or appearance as that grown in the Philadelphia district.

Fig. 16. Strains of Golden Celery grown in Philadelphia County Demonstration in 1924. Left to right they are New Strain Golden, Old Strain Golden, Golden Plume, Dwarf Golden, New Golden and Golden Self Blanching.

Several of the different sorts of Golden celery now on the market are well illustrated by Figure 16 in which are six strains grown in a Philadelphia County demonstration in 1924. The table below shows too the variation in yields of different grade stalks for every one hundred feet of row:

Table 4

	Yields per 100 feet row			
	Single stalks 1st size	Bunches of 3 2nd size	Bunches of 4 or more culls	Market Value
New Strain Golden	19	50	2	10.78
Old Strain Golden	4	45	3	8.73
Golden Plume	67	45	3	13.98
Dwarf Golden	15	40	2	8.65
New Golden	44	45	1	11.87
Golden S. B.	4	50	4	9.73

The Golden Plume is without doubt the most promising strain of yellow celery now on the market. Its only weakness is that it does not store well in the field but must either be sold in the fall or held in cold storage.

The late green types of celery as Fordhook Emperor and Giant Paschal are liked on markets where they are well known, and especially where the grower sells directly to the consumer. These sorts are undoubtedly superior in eating quality to the quickly maturing varieties and will keep well through the winter months, but they lack the fine appearance of the yellow type.

Seedsmen Furnish Celery Seed

Experienced celery growers understand that the success of the celery crops depends to a considerable degree upon the quality of the seed they plant. Survey reports indicate that only a few Pennsylvania growers save their own celery seed in whole or in part, the remainder depending largely on commercial seedsmen for their supply. This is perhaps to be expected since the plants have to be held over winter for seed growing, no easy task in Pennsylvania due to uncertainties of the winter weather. One of the celery seed growers of the state has commercialized this phase of his work and places on the market seed from strains of both Easy Blanching and Golden Plume varieties.

Many Types of Soil Used

It has already been noted that only two of the important celery sections of Pennsylvania are located on soil that approaches the ideal for this crop, i. e. muck.

Evidence indicates that water supply is the limiting factor in commercial celery production and this accounts for the popularity for celery of muck soils or others made high in water holding capacity through the use of large amounts of animal manures. Muck soils are undoubtedly most economical for large scale celery production since little animal manure is required in them. However practically any productive soil in Pennsylvania if it does not bake badly and if reasonably free from stones may be made suitable for the growing of celery as is indicated by the use of rather heavy clay loam in the Philadelphia district. On the sandy soils it is particularly desirable to be able to supply water at critical periods through some system of irrigation; with irrigation the grower may also be able to use greater amounts of commercial fertilizer and cut down on the usual manure applications.

No Definite Rotations Followed

Celery occupies no certain place in the rotation of the market garden. Occasionally the late crop follows an early spinach or cabbage planting but more often a green manure crop or animal manure is plowed under in early June and the ground allowed to lie fallow with an occasional harrowing until celery is ready to plant.

The early crop is planted on ground plowed in fall or early spring and may be followed by any quickly maturing fall vegetable as spinach or lettuce or by a cover crop as rye and vetch.

Heavy Feeding Required

It is to be expected that, owing to the particular requirements of the celery plant and the great variation in the conditions under which the crop is grown in Pennsylvania, no one method of fertilization should have been found useful everywhere in the state. The following reports of growers bring out the chief differences in methods of fertilizing; all of them indicating that the crop responds to heavy feeding.

1. Heavy applications of manure for a spring crop like spinach, complete fertilizer in the row under late celery.

1a. Ground limed, 20 T. manure per acre, 1600 lbs. 4-8-10 along row after celery is well started. (Philadelphia County).

2. Twenty-five tons manure per acre, also 500 pounds of the following mixture; 100 pounds 2-8-3 mixture, 100 pounds acid phosphate, 100 pounds sheep manure. Manure applied broadcast, fertilizer and sheep manure in the rows. (Bradford County).

3. No lime or fertilizer, manure only. Ground rotated frequently. (Delaware County).

4. 600 pounds high grade fertilizer, 300 pounds nitrate of soda, five tons well rotted manure, 1000 pounds lime. (Bucks County).

5. 15 tons animal manure, 1500 pounds hydrated lime per acre.

5a. Lime every two or three years, heavy covering of manure every year, rye cover crop nearly every year, 200 pounds nitrate of soda. (Lycoming County).

6. No lime. 1600 pounds 2-8-10 fertilizer, generally a little manure. (Muck soil, Tioga County).

7. 16 to 20 T. manure, 1600 lbs. 4-8-6. Ground limed. (Luzerne County).

8. Well rotted manure in trench, chicken manure top dressed after growth begins at rate of one pound to three feet of row. No commercial fertilizer. (Lehigh County).

9. Precede celery with winter cover crop of rye or rape, when celery plants have well started, soil thrown back from row, fertilizer drilled close to row at rate of 600 pounds per acre. soil returned. (Northampton County).

From these reports it will be seen that animal manure is a universal favorite for celery in Pennsylvania although recently green manure crops have assumed importance. When celery is but one of numerous vegetable crops on the same farm manure is usually broadcast at rates up to 25 or more tons per acre. When manure is scarce, the manure is sometimes placed in trenches immediately under the plants.

In spite of the large amount of organic matter present in muck soil, market gardeners usually find it desirable to use some manure on these soils, chiefly to provide the bacterial life necessary in every productive soil. The muck soils commonly need more potash and phosphoric acid, and less nitrogen. than other Pennsylvania soils.

Where much manure is used for celery, there is less necessity to apply fertilizers rich in nitrogen. When manure is but little used, growers commonly use at least 5 per cent ammonia in mixed fertilizers, and 8 to 10 per cent of phosphoric acid. A few, as shown above, use nitrate of soda as top dressing. A thousand pounds of high analysis fertilizer is about the average application.

Lime applications immediately before celery is planted are not considered necessary by the majority of Pennsylvania growers, although, in general, lime is applied to land on which celery is grown every three to five years, using 1 ton or more of ground limestone per acre.

Where large amounts of manure are used, there appears to be less need for lime. As commercial fertilizers come into more general use for celery, to the partial or total exclusion of animal manures, lime will probably be found even more beneficial than it is considered to be under present cultural conditions for this crop.

Several growers have been producing profitable crops of celery by the use of green manures alone in place of animal manure. Notable among these are the seeding of sweet clover in March and plowing it under in June on land to be planted to celery in July in the Philadelphia district; and the use of rye and vetch preceding celery in Luzerne County. In both cases the green manures are supplemented by generous application of high grade complete fertilizer and lime.

Most Plants Grown in Field

For the extra early crop of Pennsylvania celery, seed is sown in hotbeds or greenhouses from February 1 to March 15 and transplanted once or twice before field setting. Earlier seeding than these dates above which makes it necessary to hold the plants a greater length of time in the seed beds, is considered an important factor in causing the plants to bolt to seed. During the season of 1924 a large proportion of the extra early crop bolted to seed. This trouble may have been due in some cases to the fact that the plants were held too long in the frames since the unfavorable weather prohibited planting in the field at the usual time, and in other cases can be traced to prolonged periods of cool weather when the plants were in the cold frames or in the field. Other factors may have some influence on premature seed stalk formation.

Second early and late crop plants are commonly grown out of doors in a seed bed or in cold frames and are seldom transplanted until placed in the cropping field. The early celery is set in the field as soon as the weather gets somewhat settled in the spring, and the late crop from June 1 to August 15 depending on the variety, the length of the growing season and the time wanted for market.

Because the celery plant requires cool weather and abundant moisture for best quality and highest yield, and the early plants may therefore have to be nursed through unfavorable conditions, the late crop is more popular than the early one. Nevertheless the demand for celery in the summer encourages the growth of the vegetable at that time.

Fig. 17. Celery blanching with boards, Tioga County.

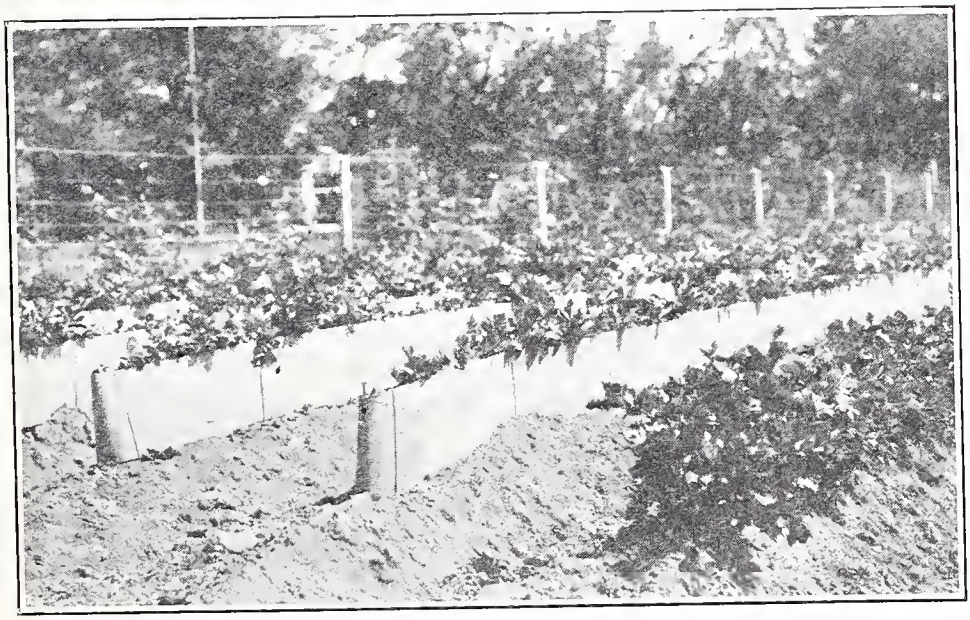


Fig. 18. Celery blanching with a prepared paper. Bustleton, Philadelphia.

Between the rows growers allow as little as two feet and as much as five feet while in the row plants are set as close as 3 inches but more often 5 to 7 inches. Spacing in the row depends largely on the variety and between the rows on the method of blanching. Blanching with boards or paper permits closer planting than does earth blanching. The closest planting noted in any celery field was 9 x 9 inches. Such a method forces the plants to blanch themselves except along the outer edges of the plot.

Practically all commercial celery in Pennsylvania is grown with level cultivation during the early part of the season, with enough earth drawn to the plants when they are about half developed to induce them to make an upright growth. Little earth is used for the early crop because of rusting but the late crop is frequently ridged quite high when it is desired to have the celery blanched for late fall sales. If the crop is stored most of the blanching is done in the storage trench or cellar. Very thorough cultivation is practiced for celery, especially with growers who use large quantities of manure for the crop and thereby introduce weed seeds.

Blanching Methods Differ Widely

The time required for blanching differs with the variety, the season of the year, and weather conditions. The earliest celery is almost always blanched by means of heavy prepared paper strips, unrolled and set on edge against the row, boards used in the same way as the paper strips, or paper collars. These methods rank in popularity in the order named. Paper is light in weight as compared to boards, cheaper to buy and more conveniently handled and stored. A patent reel now perfected permits quick unrolling of the paper along the row. It also provides for re-rolling the paper after blanching is completed so that it may be used again for other rows and during several seasons. The weight of the boards is of some advantage in pressing the tops of the plants together and the boards find other uses out of blanching season in building cold frames and supplying covers for trenched celery or other vegetables. They are also less affected than paper by rains and winds.

The paper collars find restricted use, where the plants happen to be irregular in size or where only a small amount of celery is being grown. Setting celery from 6 to 9 inches apart in wide beds is occasionally practiced to further self blanching. The late crop is blanched by the methods used for early celery, by hilling with earth, or the larger part of the blanching process may be given in the storage trench.

An average gross return of $800 to $1000 per acre is expected from celery by market gardeners of the Philadelphia section. The average

yield according to crop estimates report runs generally from 200 to 225 crates per acre.

Blight is Worst Disease

The principal troubles reported by Pennsylvania celery growers and the methods used for their control follow:

Celery Caterpillar and Leaf Tyer are occasionally controlled by spraying or dusting with arsenate of lead. Neither are common pests.

Celery Blights are apparently best controlled in Pennsylvania by spraying with Bordeaux mixture, though copper dusts have also been used with success.

Crown Rot. Especially serious with yellow varieties as Golden Self Blanching. Golden Plume, an improved strain of Golden Self Blanching is resistant to the disease.

Hollow Stalks. Usually eliminated by using good strains of seed and by providing satisfactory growing conditions.

Rotting in Storage: Due to improper storage conditions, blight infection or other damage that started in the field, or stalk weakness from over-fertilizing with nitrate of soda. Controlled by regulating these conditions.

It was noted in 1924 that celery sprayed regularly through the season withstood the severe November freeze better than did the unsprayed celery, and also kept better in storage due to more healthy foliage and stalks. Many growers are now spraying every week to ten days through the season, starting soon after field setting and applying a maximum of 200 gallons of Bordeaux mixture per acre. A few apply the first spray in the seed bed.

MARKETING CELERY

Celery is quite plentiful in many Pennsylvania markets in the late fall because fifty per cent of the commercial growers in this state sell directly from the farm, not wishing to run the risks of severe losses that frequently occur with field stored celery.

If celery is to be held for some time, the stalks should be very little blanched when placed in storage. For this reason the self blanching types which naturally lose some color as the plants mature, do not keep as well as the "green" sorts.

Celery blight may progress greatly after the crop has been stored. This is one reason that the foliage should be kept free from this disease, through systematic spraying.

Probably nine tenths of Pennsylvania celery that is not sold in the fall is stored in well drained trenches out of doors. The whole process of celery trenching is modified to suit the length of time the crop is to be held in storage. Ventilation of some sort should

be provided for long trenches. Boards or a cheap building paper are used to make the ridge-shaped coverings for the trenches. Further covering of earth or manure is added gradually as the weather becomes colder. Rotting of celery in the trench in the Philadelphia section has sometimes been ascribed to very heavy top dressings of nitrate of soda that caused such rapid growth as to make the stalks too soft to keep well.

Special buildings for celery storage and ordinary storage cellars have been provided by a few Pennsylvania growers. Adequate and certain storage facilities would remove much of the risk from celery production. Fully satisfactory celery storage must have better ventilation than is provided by the cellars now used for this purpose and there should be means at hand to lower the temperature during the warm periods of late fall, as well as to guard against freezing. Several growers expressed the opinion that a cooperative cold storage warehouse would be most desirable in the more intensive celery sections. There is little data regarding either the best methods of packing celery for storage or the ideal temperatures at which this crop should be kept. A Philadelphia market gardener was most successful in holding Golden Plume in cold storage during the early winter of 1924 and plans to increase the amount of his celery stored by this method.

The Vegetable Survey revealed clearly the scarcity of home grown celery in Pennsylvania during the winter. Especially on the smaller markets, imported celery, handsome, but much of it less palatable than home grown, is the only sort that can be bought after Christmas. It would appear that there is no vegetable crop more neglected by the growers near the smaller towns than is celery, and no crop that would better repay the skilled gardener. However, better storage methods must probably be provided before Pennsylvania celery is found generally on our markets during the late winter months.

Better Grading is Needed

Pennsylvania celery as a rule is not very well graded and suffers by comparison with well-sorted stock from certain other states. There are a few growers who make two or three grades according to size. Most of the Pennsylvania celery is placed in flat bunches of three to six stalks, string or a wire at the root end, while the leaf end is tied with common twine. The roots are cut to form a pyramid about an inch and a half long and the bunches are washed after tying. The celery from the muck sections as Tioga County is only partially trimmed and washed and tied in bunches of twelve. The larger types produced in other sections, such as Golden Plume, are tied in the same way. Round bunches of four or five stalks are common on local markets.

The standard celery crates are used in the shipping section, elsewhere the celery is packed in the containers used locally for other vegetables. Two market garden farms near Philadelphia sell their celery in special crates holding 100 to 125 stalks. This is a fancy package that makes a fine appearance and results in an advanced price for the product.

Carlot unloads of celery on the Philadelphia market in 1923 and 1924 are shown below:

State	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	1924	1923
Calif.	45	21	10	6	2	2	1	------	------	------	3	33	123	132
Fla.	56	142	129	120	41	5	------	------	------	------	------	------	493	382
Mich.	------	------	------	------	------	------	1	2	------	2	------	------	5	—
N. J.	3	1	------	------	------	------	5	6	21	20	5	2	63	39
N. Y.	52	------	------	------	------	------	3	15	25	45	97	158	395	212
Pa.	------	------	------	------	------	------	------	13	26	51	16	------	106	84
S. C.	------	------	------	1	------	------	------	------	------	------	------	------	1	1
1924	156	164	139	127	43	7	10	36	72	118	121	193	1,186	------
1923	117	106	133	120	33	9	2	18	32	108	39	133	------	850

ONIONS

Green bunch onions are grown in practically every market garden section of Pennsylvania and in nearly all home gardens. The mature bulbs, grown generally from seed, are well adapted to the needs of the trucker in neighborhoods somewhat removed from market, since they ship well but are grown regularly on a carlot scale in only two sections of the state. The first area is the northern part of the Pymatuning Swamp in Crawford County, the second around several towns in the eastern half of York County.

Narrow strips of black muck soil west of Erie paralleling the lake shore have been planted in onions to a limited extent for many years. In Luzerne County in 1924 there were from 60 to 100 acres in onions, most of this being in onions grown from seed on river bottom soils. The largest acreage controlled by one operator was 25. In southern Wayne County close to the Lackawanna County line are small areas of muck soils on which onions and other vegetable crops are grown. Except for the five localities just mentioned, the onion acreage of Pennsylvania is much scattered, and there are few plantings except in those localities that are over an acre in size.

A considerable tonnage of this crop is annually imported into Pennsylvania from other states that are well supplied with the muck soils in which the onion grows so well.

Pennsylvania in 1923 is credited in Crop Statistics records with harvesting 280 acres of domestic onions with a yield of 200 bushels per acre. Both the acreage and yield were lower than from 1920 to 1922 when the former averaged 345 acres, and the production 333 bushels per acre.

Green onions are grown from,

1. Multipliers as Egyptian or Potato onions and fall seeded onions which produce the earliest "Scallions."

2. Ordinary onion sets, the second early crops.

3. Seed onions, following in season the onions from common sets.

Mature bulb onions are produced from sets, seeds, and plants started in greenhouses or frames and transplanted to the field.

Onions Particular as to Soil

The onion plant has delicate roots that are unable to forage for food through a hard or a stony soil that would offer little resistance to more woody roots. Soils that form hard crusts after rain offer poor conditions for the germination of onion seeds. Stony soils are undesirable too because the stones knock down the tender plants during cultivation. Soils full of weed seeds are disliked for onions not only because weeding of the rows is tedious and expensive but also because the removal of weeds easily disturbs the growing onion seedlings.

Onions from sets for either bunching or mature bulbs may be grown and are grown on practically all soils of the state. While all Pennsylvania soils are not equally well adapted to the crop, many of them may be changed through manuring and fertilizing to make them suitable.

Onions grown from seeds for bunching will do well in many market gardens soils in the state, as sandy loam river bottoms, that are free from stones, or other types where good germination of seed and favorable growth of the tender seedlings may be secured. Such early soils may not however, be suitable for crops of mature bulbs from seed unless irrigation is provided, since for the mature onion crop a constant supply of moisture in summer is required. Lack of soil moisture accompanied by high temperatures reduces onion yields through too early maturity of the bulbs.

The muck soils are undoubtedly the best general type for the growth of mature onions from seeds. At least one Pennsylvania gardener has excellent results with onions on a piece of upland glacial soil from which he removed many tons of stones. While industry of this kind is generally to be commended, it seems wiser to plant such stony soils to other crops than onions, especially since this crop is easily shipped in from other sections possessed of better natural soils.

The most promising soils for future onion growing in Pennsylvania are those of the drained glacial lakes and ponds in the northeastern counties, small areas of muck soil not affected by a water

supply project such as will probably destroy the Pymatuning Swamp in Crawford County, and still smaller spots of black soil scattered over the state. Many of these old lakes and ponds are not now in condition for the growth of any cultivated crop, needing chiefly drainage and clearing. The most satisfactory development of onion growing on such soils will result when several hundred acres can be put into condition at one point, or when an equal area may be planted by several growers living near one shipping point or along one railroad line. As dry onions are preeminently a product to be shipped in carlots, sooner or later the single grower, or association of growers, that can control a considerable acreage will enjoy advantages in convenience of shipping and satisfactory marketing not possessed by the small individual grower.

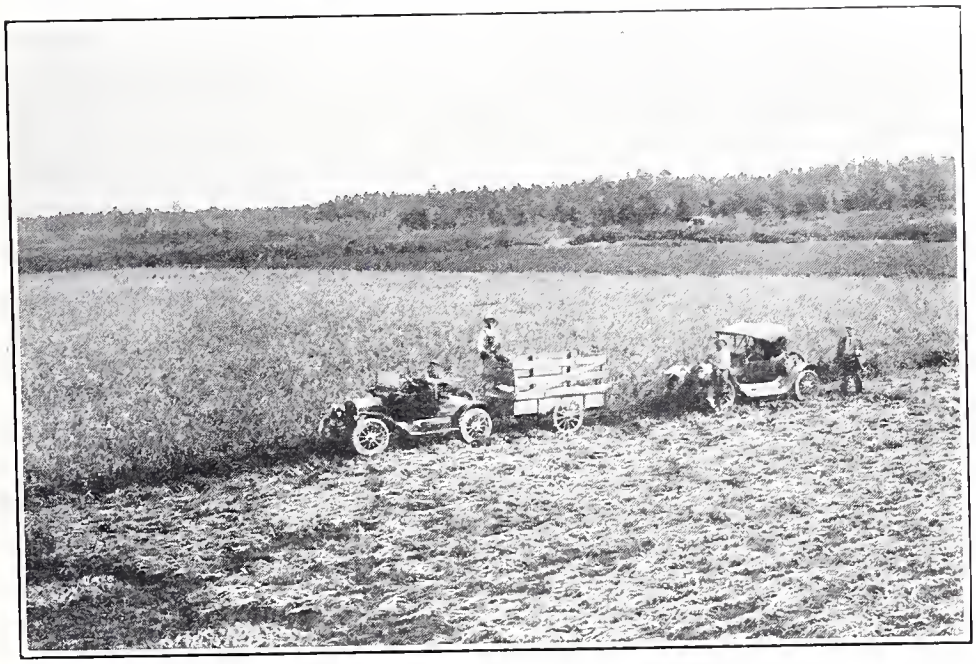


Fig. 19. Harvesting of Mature Onions, Crawford County.

PRODUCING ONIONS SUCCESSFULLY

For dry onions grown from seed, 65 per cent of the Pennsylvania growers use yellow globe varieties, including Danvers, Southport, and Ohio Yellow Globes, and various strains of these. Twenty per cent use the Prizetaker, really a yellow skinned onion, while the balance prefer the white varieties as White Portugal, White Pearl, and Southport White Globe. The first two of these white onions are also grown for pickling. No grower in the state reported using a red variety.

The preference for the varieties used probably is due to the following facts: Pennsylvania markets do not favor the red onion possibly

because of its comparatively strong flavor, though it is the best keeper and is liked in many other states. The yellow onions are not as good keepers as the red, but are better than white onions in this respect. White onions are more particular about their growing conditions than either the red or the yellow onions.

Some markets prefer the white onions since they are mildest in flavor (excluding Prizetakers). When liberally fertilized and grown on favorable soils Prizetaker is perhaps the highest yielding variety grown in the state and is favored for its mild flavor. However it does not keep as well as the yellow globe varieties and will not do so well in all seasons as a variety like the Danvers.

The earliness, good keeping qualities, and reliability of the Danvers Yellow Globe have made it popular throughout the state, though some growers report both Southport and Ohio as better yielders. The Australian Brown finds some use in Pennsylvania because of its fine keeping qualities. The bottle or banana type onion grown on a small scale in some sections is desirable for its keeping qualities and for its fine appearance when sold as a bunching onion.

Of onions grown for bunching, varieties are seldom mentioned or in fact known by the growers. It is either "yellow" or "white" sets that are planted, with the state equally divided between the two colors. The White sets are considered to make a more attractive bunch onion. Egyptian and potato sets are used for the growing of early spring bunching onions in a very small way, chiefly by the farm truckers and home gardeners, although they furnish the earliest scallions on the market.

Japanese or Ebenezer sets, which produce a crop of good-size mature bulbs without loss through the development of seed stalks, should become more popular for the production of dry onions on soils unfavorable to the growth of the onion seedling.

Seed Usually Purchased.

Home gardeners have found onion seed growing not a difficult matter, but large growers have apparently not found it profitable and rely almost entirely on commercial seedsmen for their supply. This is perhaps due partly to the difficulty of holding onions until spring on the average vegetable farm.

It is less difficult to keep sets satisfactorily over winter than market-size dry onions and we find consequently that a few of the bunching onion growers do produce their own sets. The larger growers of onions from sets however almost invariably buy their sets from dealers. Both seed and set growing are specialized practices best carried out in the particular regions of the United States suited to their culture and by those who are equipped for them.

Soil Thoroughly Fitted

The needs of the onion plant as to soil have already been mentioned. This crop will not tolerate a cloddy or a stony soil, nor one full of coarse stalks of corn or weeds. Good onion fields are kept in such tilth that the soil may be made very level. The plank drag and the meeker harrow find wide use in Pennsylvania onion fields for final preparation of the soil before seeding.

On the Crawford County muck soils, spring plowing is usually dispensed with unless the weeds have become too thick, and a disc harrow is used. In some of the fields heavy undecayed logs lie near the surface and snag a plow but the disc will pass over these logs. The discing is of course more rapid than plowing.

One of the largest onion growers near Linesville discs, drags, harrows with an acme harrow, uses the plank drag again, and is then ready to plant the seed. On other soils than mucks, the meeker harrow is particularly useful in breaking small clods and making the soil fine for onion seeding.

As it takes several years to prepare land for successful extensive onion growing, it is the custom to grow this crop every year for an indefinite period without rotation.

Onions Respond To Heavy Fertilization

Twenty-five tons of animal manure to the acre is about the average application in Pennsylvania for onions on soils other than muck, with amounts running to 40 tons. Muckland onion growers who do use animal manure, generally use less commercial fertilizers than those who do not, and the manure here is no doubt used for its fertilizing value. On other soils the value of the manure is considered more from the standpoint of its water holding power and its physical effect on the soil. The manure must be well rotted if applied in the spring.

Growers agree that few vegetable crops respond better to heavy fertilization than onions. While commercial fertilizer applications range from 300 pounds to a ton per acre, depending on the soil and the amount of manure used, a half ton seems to be the most common rate. Almost without exception mixed goods are used, with ammonia ranging from two to six per cent, phosphoric acid eight to ten per cent, and potash four to ten per cent. The muckland operators recognize the special need of their land for potash and either use a mixture carrying ten per cent of potash or apply wood ashes. Top dressing with nitrate of soda was reported by only a few growers in the state, though undoubtedly many others practice it.

For the growing of winter onions, manure is used as a mulch for the crop. However, in cool spring weather when these onions make their growth, manure will not furnish the nitrogen needed for quick

development, so that soluble nitrogen in the form of nitrate of soda or sulphate of ammonia has proved especially useful for this crop.

Lime is used specifically for onions by half the growers who reported their practices. This proportion holds even on muck land, which is usually thought to require much lime. Actual acidity does not seem to be as injurious in soils rich in plant food, especially if they are also rich in organic matter, as it is in less fertile soils. As all onion soils are highly manured and richly fertilized, it seems likely that even this crop which is generally agreed to be intolerant of soil acidity may not require heavy and frequent lime applications.

Onions Seeded Early

Onion seed is usually planted in Pennsylvania as soon as the ground is dry enough in spring to be put into proper condition. This date will often precede the frost-free date by a month or more. Sets are planted as early as or earlier than seeds, when onions are to be grown for bunching. The soil may be in a slightly less favorable condition for set planting than for seed planting, although if the sets are planted for mature bulbs nothing is gained by unduly hurrying the planting. The top and potato onions are planted in late summer, about September 1.

Transplanted onions, as the Prizetaker, started in greenhouses or frames are usually set in the field after the weather becomes somewhat settled in the spring, or approximately a month after the earliest date for seed or set planting.

Rows for both seed and set onions range from 12 to 18 inches apart, with 12 and 14 being the most common spacing. One grower who uses a horse in cultivation places his rows 22 inches apart. At that spacing it requires a careful horse to do the work without injury to the plants. From four to six pounds of seed are used for an acre of onions to be grown to maturity, 60 to 100 may be none too much for a crop of set onions. Were it not for the danger of injury by onion maggot in many parts of Pennsylvania, one-third less seed would be sufficient. The maggot may be controlled by the growers and the saving in seed would go part way toward paying for the materials needed. When ordinary sets are planted for mature bulbs, it has been found desirable to use graded sets, those under three-fourths of an inch in diameter, and over one-half inch, being most desirable. The large sets often produce seed stalks, while the smaller ones make smaller bulbs. The Japanese or Ebenezer Onion is most desirable for this purpose, however, as it "shoots" few seed stalks.

Seed drills, are used generally for onion seeding. Some of the large onion growers used gang drills, from 3 to 6 rows being planted at one time. This makes possible also multiple cultivation of the same rows. The planting of onion sets is one of the most back

breaking tasks of the market garden, and this labor has probably deterred many gardeners from the growing of a greater acreage of mature onions from sets. Planting machines now on the market are coming into more general use for this work.

There has been at times an interest in the method of onion growing which involves the transplanting of growing plants started indoors. The variety used is almost always Prizetaker. Larger and more perfect bulbs can be grown by this method but because of the heavy expense and difficulty involved in growing and transplanting the plants, the majority of those who do plant the Prizetaker variety, prefer to sow the seed directly in the field and depend upon the average larger size and mild flavor attained by this variety to bring a higher price than the common yellow globe onions.

Regular Cultivation and Weeding Needed

Except when an attempt is made to produce bulbs of unusually large size and uniform shape, onions are seldom systematically thinned in Pennsylvania. Growers do not believe that perfect onions developed after careful thinning bring a sufficiently higher return to justify the labor expense. The tendency is therefore to seed just thickly enough to give a good stand of plants, and remove here and there excess plants only as the crop is hand weeded.

The use of manure in large quantities on onion land introduces weed seeds and favors the growth of weeds. Perennial weeds seldom get a root hold in old onion land, however, owing to the fact that onions are so frequently grown on the same soil year after year, and constant cultivation is given to conserve moisture as well as keep down the weeds. Two to four hand weedings are usually necessary.

Owing to the expense of properly caring for an onion field after seeding, special methods and tools have been devised to do the work rapidly and easily. Wheel hoes or power cultivators are commonly employed, but the standard sweeps used with such equipment for weeding have been modified by many of the growers by increasing the sweeps' vertical surfaces in height so that the soil cannot push over the top of them and fall on the tender seedling. Several machines designed especially for weeding onions have been tried out in the state but so far, without satisfactory results. When only cultivation and not weeding is desired, growers use any of the common five tooth wheel cultivators. The small power cultivator equipped with three row seeders and three row cultivators is becoming popular as an efficient labor saver on large acreage of onions. A Luzerne County gardener has improvised a six row weeder for his onion crop. Late in the season when the tops of the onions tend to break over, if cultivation is carried on after this time, some kind of guard that raises the leaves away from the cultivator wheels is provided.

METHODS OF HARVESTING AND CURING ONIONS

With minor modifications the usual methods of harvesting and curing onions are used in Pennsylvania. Periods of dry weather in August and September, or July for the extra crop, are desired by the onion grower to bring the crop to maturity and assist in curing. If the weather is unfavorable for curing, the onions are sometimes pulled and placed directly in ventilated crates under shelter; in such a case topping is done later in the season. Ordinarily however, where the onions have been pulled and cured in windrows, the tops are removed, with sheep shears or knife before the bulbs are placed in the crates. Some Pennsylvania growers have gangs of boys remove the tops of the onions before they are pulled, other gangs following to remove the onions and throw them in windrows for curing. It is always a question whether "thick necks" that cure very slowly if at all ought to be crated with the rest since they continue to give off moisture in storage and thus reduce the keeping quality of the entire lot.

Onion topping machines have not won widespread approval in Pennsylvania. Growers claim that these machines bruise many of the onions, and this leads to spoilage in storage unless unusual attention is given to ventilation so that the bruised spots dry out thoroughly.

Few Pennsylvania Onions Stored

At least three fourths of Pennsylvania grown dry onions are sold before freezing weather makes storage necessary. Unlike root crops and cabbage, onions cannot be stored in the average house or other storage cellar since they require a dry atmosphere. The only special onion storage house found in the state was one operated at Linesville. This is a well insulated structure with a capacity of 1800 bushels, heated when necessary by stoves to maintain a temperature of 28°F.

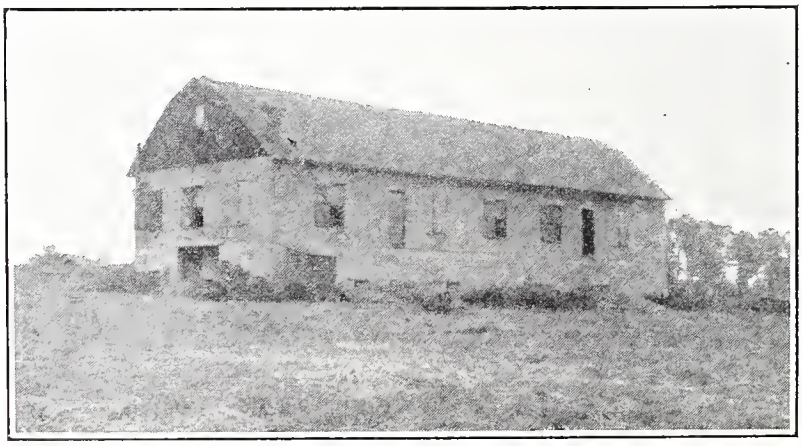


Fig. 20. Onion storage house at Linesville, Pa.

It is not always used to capacity since the onion men say that it does not always pay to store. The building is conveniently located close to both the onion "marshes" and the railroad. The crop placed in storage here is sorted according to size by a home made grading machine located in the basement of the building.

While yields of onions up to 1,000 bushels per acre have been reported, a yield of half that amount is considered good. Three hundred and four hundred bushels yield are more common. A Wilkes-Barre gardener reports an average of better than 800 bushels per acre in 1924.

Insects and Diseases

There are three insects that have caused greatly reduced yields as well as reduction of planting in Pennsylvania onion fields, the cabbage maggot, the onion maggot and the onion thrip. The cabbage maggot is controlled by treating the seedling plants with corrosive sublimate solution. The onion maggot is destroyed on a large scale by a special poison bait placed in shallow cans in the field immediately after the seed is sown and carefully replaced after heavy rains or during periods of drought. For use in small onion plots or in the farm vegetable garden, carbolic acid emulsion is recommended for onion maggot control. Rotation, clean culture, and destruction of crop refuse are of special value in reducing maggot infestation.

Onion thrips are controlled by using a coarse drenching spray of 40 per cent nicotine sulphate, ½ pint to 50 gallons of water plus 2 pounds of soap, directed into the axils of the leaves with considerable pressure. For the small plot a 2 per cent nicotine dust is satisfactory but is more expensive than the spray for large scale operations.

Onion smut, the most serious disease of this crop is fairly well checked by directing into the ground around the seed a formaldehyde solution, 1 ounce 40 per cent formalin to a gallon of water. Such solution is flowed about the seed from a special tank mounted on the seed drill, using 3 to 4 quarts to a hundred feet of row.

Soft neck or thick neck onions are generally caused by a poor strain of seed or by moist weather just previous to harvest time. Using only the best seed partly overcomes this difficulty.

Grading Is Practiced In Some Sections

Most markets prefer a medium size onion. Undersized ones naturally will not sell well, and if larger ones are desired the trade usually buys Bermudas. A few of the larger growers use a rack grader making three grades. The first is 1 7/8 inches and larger, the second grade known as "boilers" is 1 to 1 7/8 inches in diameter, while the third grade, all under an inch in diameter, are sold as "sets."

There is no particular package used for Pennsylvania bunch onions and the same is true of mature onions in sections where small amounts are placed on local markets. For shipment from the main onion districts, as Crawford County, 100 pound, open mesh sacks are usually used. For local shipments second-hand grain sacks are often employed.

The larger growers load and ship in carload lots, selling mostly directly to wholesalers. A few have sold to commission men, nearly all dispose of a portion of the crop in small lots to nearby retailers and wholesalers, while the smaller growers often sell their crop field run on the "cash track" plan.

The carlot unloads on the Philadelphia Market in 1924 and 1923 were as follows:

State	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	1924	1923
Calif.	1		1		6	74	14						96	43
Ill.													—	6
Fla.					2								2	—
Ind.	29	34	25	6				1	25	31	31	24	211	170
Impts.	9	5	8	11	22	28	16	9	22	11	20	12	173	207
Ky.							2						2	—
La.													—	7
Mass.	35	48	40	41			12	71	23	39		2	311	291
Md.							10						10	—
Mich.	15	30	23						2	7	28	23	128	6
Minn.												5	5	106
N. J.							6	13	4	6			29	29
N. Y.	52	28	44	65	5	1		30	87	92	69	98	580	504
Ohio	52	47	37	12				1	51	39	25	41	305	165
Penna.								8			1	1	10	30
Texas				25	100	42							167	238
Va.							30	5					35	60
Wash.							2	1					3	14
1924	193	192	178	160	135	145	92	148	214	225	179	206	2,067	
1923	174	112	137	95	211	101	116	121	155	207	162	199		1,790

SWEET CORN

It might be said of Pennsylvania that she furnishes sweet corn from her soils throughout the year. For not only is the crop grown commercially in nearly every county of the state, but the corn canning and drying industries in Southern Pennsylvania are of considerable importance.

Sweet corn is in many ways like field corn with respect to cultural requirements, and in Pennsylvania is commonly handled much like that crop. The ease of culture has also affected the marketing of the crop and the choice of varieties, since the midseason market, at least in the smaller cities, is almost always overstocked with sweet corn. One result of this has been a close competition for the earliest market.

Pennsylvania ships no sweet corn in carlots probably due to the fact that our markets are supplied largely from immediately sur-

rounding farms and market gardens. In this state sweet corn is preeminently a trucking crop, well suited to the general farm and less well adapted to the intensive market garden. Many gardeners having a retail trade, however, grow some corn to hold their customers.

Out of 50 vegetable growers in the Philadelphia district only ten were growing sweet corn in 1920. In York County, on the other hand, where wholesale selling is less the rule than at Philadelphia, 49 out of 53 growers planted sweet corn. Every large city in the state is served by gardeners located from 3 to 30 miles away, and every small town is supplied by farm truckers of the neighborhood. Growers in Lawrence and other counties bordering Allegheny County send sweet corn to Pittsburgh; Cumberland, Lancaster, and York Counties all send the product to Harrisburg; Philadelphia is supplied probably to a larger extent by New Jersey truckers than from Pennsylvania farms.

The corn drying business has its center northwest of the city of Lancaster. The canning of corn is confined chiefly to York County and is closely tied up with the tomato canning business.

CULTURAL METHODS FOR SWEET CORN

Since sweet corn seed is very commonly saved by growers and cross-pollination is easy, there are numerous strains and varieties having only local names. It is likely that even some of these strains that still retain the old varietal names, are now distinct from the original types, and that a list of popular varieties may be somewhat misleading for this reason. The following list of varieties is significant in the evidence it furnishes of the popularity of a few standard types, of the demand for yellow corn among the early sorts, and of the relative desirability of early as compared to late varieties. The varieties are given in order of popularity as indicated by a number of farms reporting them in 1920. The great number of sweet corn growers is poorly indicated by these numbers reporting since the survey covered few of the general farmers who grow an acre or so of sweet corn as a sideline.

Stowell's Evergreen	228	Early Evergreen	5
Howling Mob	54	*Golden Evergreen	5
*Golden Bantam	53	Baumgardner	5
Early Adams	42	Double Barrel	4
Cory	29	Ideal Early	4
Premo	23	Columbus Market	3
Country Gentlemen (including Shoepeg)	21	*Golden Giant	3
Kendel Early Giant	9	Early Minnesota	3

*Yellow or cream colored varieties.

It will be seen that seven varieties include all that may properly be called popular commercial sorts. Stowell's Evergreen monopolizes the midseason and late market, throughout the state. The size of the ear and the depth of kernel of this variety make it a favorite. The same factors, which contribute to a heavy yield, make this sort useful in the corn canning and drying sections of the state, although it is generally admitted that Shoepeg or Country Gentleman makes a better grade of corn. (These variety names are used interchangeably though Country Gentleman is an improvement of the old Shoepeg variety). The canners therefore like to pack Shoepeg and the growers would rather plant Evergreen. The result is that both varieties are grown for canning.

Yellow Varieties Increasing in Popularity

The place of Howling Mob on the list is somewhat surprising, since this variety is by no means an old one. Golden Bantam has made rapid progress on Pennsylvania markets. In other states, it is canned to a limited extent, but no record was found of the canning of yellow corn in Pennsylvania. With many corn buyers the Bantam has been criticized because of its small size, and growers and breeders have attempted to combine in one variety the quality of Golden Bantam and the larger size of varieties like Evergreen. For that reason we find grown frequently such varieties as Golden Evergreen, Golden Giant and Golden Beauty. That Golden Bantam is steadily increasing in popularity is indicated by the statement of a Pennsylvania seedsman who says that his sales of Golden Bantam seed have increased tenfold from 1920 to 1925.

Varieties of sweet corn with the greater sugar content are less resistant to rotting in cold wet soil of early spring than the more starchy types. At the same time the earlier the variety the more susceptible it seems to be to Bacterial Wilt.

The old favorites, Adams, Cory, and Premo are still planted widely. It is probable that Cory is among the very oldest varieties known in America. The absence of Black Mexican from the list is significant since the color discredits it in spite of its high quality.

Little difference in the distribution of these varieties in different parts of the state has been found. Growers in the eastern counties do show a tendency to use a larger number of varieties than those in the western counties. Single growers report four or more kinds on the one farm, and these not all suited to succession marketing. Western Pennsylvania growers are apparently more inclined to limit themselves to one variety or at most to two, an early and a midseason. This difference may be due to the more frequent contact, in the east, between grower and consumer, in which case the grower

may raise several sorts to appeal to differing demands of his customers. In the western counties it is probable that the demands of wholesalers, commission men, and retailers have a larger influence on the choice of varieties, and only standard sorts are in demand.

Many Growers Save Own Seed

Of 130 Pennsylvania vegetable growers who in 1920 reported saving some seed at home, 64 saved seed of sweet corn. The nearest competitor of sweet corn in this respect was the tomato, which was being grown from home raised seed on 37 of the 130 farms. Many canners of sweet corn have believed that imported seed, especially that coming from more northerly localities, it to be preferred above the home grown stock. Satisfactory seed of sweet corn can be grown in any part of Pennsylvania provided the right care is taken to prevent mixing with field corn or with other varieties of sweet corn and that the fields are rogued for disease.

On general farms where early or second early varieties are grown, sweet corn is apt to take the same place in the rotation as field corn, and may even make part of the field corn plot though this is not desirable when there is likelihood that sweet and field corn will be making tassels and silks at the same time. Evergreen corn, being practically the only late variety grown in Pennsylvania, is usually planted on larger fields than the early sorts. On smaller farms and on market garden farms sweet corn seldom has any definite place in rotations. The one condition that most growers seem to desire is the presence of a close sod on the land to be planted in corn. The crop is commonly depended upon in Pennsylvania to reduce heavy sods to a condition fit for smaller vegetables, partly because corn will make a fairly good growth in somewhat rough soil and because the frequent cultivation given this crop helps to work down such a soil.

Some Nitrogenous Fertilizer Pays

Sweet corn when planted on sod sometimes gets no additional plant food, or no more than several hundred pounds to the acre of acid phosphate or a low grade fertilizer mixture bought for the field crop. This is especially true of the late crop whether grown for market or for the cannery, since there is less chance with late corn of making large profits. Many growers, however, use from eight to twelve tons of manure even when a sod is available, and others think that an abundance of nitrogen in the fertilizer used is paid for in earlier maturity and better prices. Very early sweet corn should be benefitted by the use of at least three per cent of quickly available nitrogen in the fertilizer, and eight hundred to a thousand pounds

of high grade fertilizer to the acre should be a profitable application. A few growers use 200 or more pounds of nitrate of soda on an acre of early corn. This is undoubtedly a good practice especially in cold, wet seasons when the young plants make a poor start. Luzerne County growers apply this nitrate as a top dressing to the early sweet corn when the plants are 12 to 15 inches high.

Lime is used regularly for sweet corn on very few Pennsylvania farms. Perhaps this is because corn comes soon after clover in the common Pennsylvania rotation, and soil conditions suitable for clover will favor the corn crop also. When clover does not make part of farm rotations, a situation that is common on intensive gardening farms, it is likely that the frequent use of manure may do away with the necessity of using lime for the sweet corn crop. When commercial fertilizers are very largely depended on, however, more attention may need to be given to liming for corn. With the corn crop as with other vegetables, however, lime may be desirable partly for the crop that is to follow, or perhaps for a cover crop of clover sown between the rows.

Planting Methods Similar to Field Corn.

Sweet corn is both check-rowed and drilled in Pennsylvania, the practice being to follow the method commonly used for field corn in any locality. There is probably a tendency toward check-row planting as a means of controlling weeds with less hand labor, particularly since manure, the common corn fertilizer, almost always brings in numerous weeds. On the other hand, the planting of corn in hills may necessitate thinning, an operation that is either not required at all when the seed is drilled or that can be done with a hoe with no stooping. Stowell's Evergreen and other large varieties are handled very much like common dent or flint corn, with respect to spacing. The early varieties, because they make a smaller growth, are usually allowed to stand more closely; if planted in hills four or more plants are often left in every hill, and the distance between rows is apt to be the smallest that will permit horse cultivation.

A few Pennsylvania growers occasionally start the earliest crop of sweet corn under glass, the seed being planted in berry boxes or dirt bands two weeks or more ahead of the regular field planting season. Such practice is sometimes justified by the high prices received for this extra early corn. Its advantage would be particularly noticeable in a season such as 1924 when it was impossible in many sections because of the continual rains to get the ground prepared, and where the seed planted in the field quite early rotted in the cold, wet ground.

Vine Crops Used As Intercrops

Pumpkins and squashes are grown as intercrops in fields of sweet corn. In several of the eastern counties on gravelly or other well drained soil, watermelons are occasionally planted like pumpkins, among the hills of sweet corn. Growers who practice this plan state that the melons do just as well as in the open field and that the corn conceals the fruit and somewhat reduces loss by theft.

Experiments Show Suckering Unprofitable

Cultivation and weeding are practiced as for field corn. Control of weeds through careful cultivation in the early life of the crop is followed. Breaking of the soil close to the plants is later only shallow in order to avoid root injury. Some growers pull large weeds near the plants by hand while others believe that these do less damage if left in their places than if they are pulled away and possibly upset the root system of the corn plants during their removal.

Many growers in Pennsylvania cling to suckering of sweet corn as part of their regular practice, although the results of experimental work indicate that suckering of sweet corn does not promote greater yield.

Growers apparently agree that a yield of early corn must be above 5,000 ears per acre to be profitable. The highest yield reported in 1924 was 15,000 ears per acre of Cory variety in Luzerne County.

SWEET CORN IMPORTANT CANNING CROP

The business of drying corn for domestic use in this state was, in 1920, restricted to Lancaster County, so far as records show. At that time there were in the county seven plants ranging in capacity from 50 to 225 bushels of the dried product per day of 12 hours. The total daily capacity of the seven plants was 725 bushels per day. It was judged that on the average the product of one acre of sweet corn yielded 25 bushels of the dried product, and if this is true, the Lancaster County plants were using daily the corn from 29 acres of sweet corn.

Pennsylvania in 1923 ranked 13th among the states in acreage of Sweet Corn grown for canning with 2580 acres harvested, Illinois was first with 53,120 A., Iowa 2nd with 45,610 A. New York, Delaware, Ohio, and Maryland rank high. York County is the banner section for corn canning in Pennsylvania. There 15 canneries are on record as canning corn, their season's pack being a little over 224,000 cases. There was a marked difference in the size of pack of the several factories, the records showing 1500 cases for the smallest pack and 47,000 for the largest.

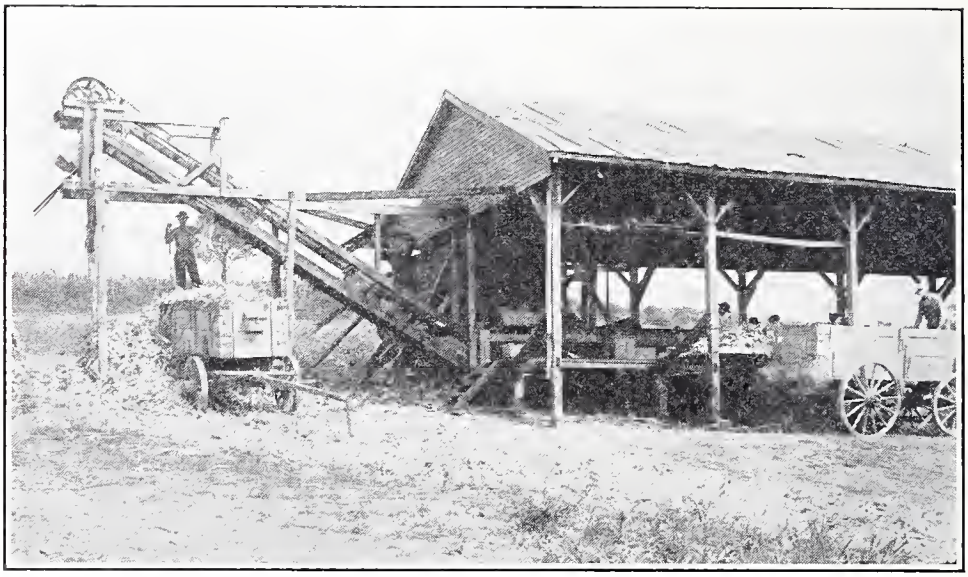


Fig. 21. View at a canning factory in York County. Corn is being delivered by the team at the right, and the people in the background are husking the ears by hand.

Sixty per cent of the sweet corn grown in York County for the factory is Stowells Evergreen and the remainder Shoepeg (Country Gentleman). From four reports of the York County canneries it appears that an acre of corn in 1920 produced about 83 cases of the canned product, which indicates a yield of around three tons to the acre. No doubt individual yields of sweet corn will run much above this; averages, in the case of most canning crops, always being relatively low. If the contract price per ton is as much as $20, the product of an acre of land planted in cannery corn with a yield of 5 tons or better should bring a fair return as compared to the common cereal crops in Pennsylvania.

Cost of production records kept on three farms, Lancaster County, Pennsylvania, in 1924 showed the net cost of producing an acre of sweet corn for the cannery to be $44.81 per acre deducting the value of the stover. A total of 30 acres was involved in these records and the average yield per acre was 4.2 tons. The average cost of producing an acre of sweet corn in 1920 on 12 farms in the Ontario area of New York state is reported as $66.69.

Sweet corn is delivered at the factory in the unhusked state and the refuse of husks and cobs may usually be secured by the farmer free. This must be considered in reckoning the income from an acre of sweet corn. Hogs are said to fatten quickly on this by-product, while the husks, and sometimes the cobs also, are frequently made into silage. Some growers think the stalks of sweet corn have a higher feeding value than do those of ordinary field corn, and these stalks are therefore an asset of the sweet corn farmer. The value of

these by-products with harvesting costs deducted was estimated by growers of the Ontario area of New York in 1920 as $11.43 per acre.

The canners all make contracts with the growers; most of them are verbal. Since 1921 the tendency has been towards written contracts. The canners furnish the seed to the growers in nearly every case and then deduct the cost from the price of the crop at the end of the season. In two or three instances the grower is given the seed free. There are two methods of paying the growers for the corn brought to the canneries. One method, which is growing in popularity, is the "sliding scale." This does not set a definite price, just a ratio to the market price, so that if the market price goes up, the contract price follows. The other method is a straight contract price for the season. This method is not very popular with either the canners or the growers. If the market price for corn rises above the contract price, the growers either break their contract or lose money, which causes discontent on the part of the canner or the farmer, as the case may be.

Corn Earworm Most Serious Pest

The corn earworm affects only the late sweet corn but frequently causes heavy losses. The control recommended for the market crop is to dust the fresh silk at intervals of 10 days until silk dries, with a dust of half arsenate of lead and half lime, flour, or sulphur. For the can-house crop, early planting will bring in the crop before the earworm starts its work. Destruction of refuse and fall plowing are effective, as well as planting a strain that silks uniformly. Cutworms, wireworms, and flea beetles are other sweet corn pests.

The corn root aphis causes damage at times in the eastern part of the state, especially where corn has been grown on the same field two years in succession. Little infestation occurs where rotation of crops is followed and ground is well prepared.

Corn borers are kept is check by clean culture and the cleaning up of corn refuse and weeds in the fall. The European Corn Borer has proved a serious pest in Erie County. The Japanese Beetle has fed upon sweet corn more than any other vegetable in southeastern Pennsylvania, entering the corn ears about silking time.

Corn smut is removed and burned whenever found to prevent spread of this disease. Smut is the only disease reported through the Survey, though there are probably others as Bacterial Wilt, that have not been recognized generally by the growers. The control of Bacterial Wilt is largely influenced by the use of resistant varieties.

Competition

The only system used in grading sweet corn is the elimination of "Nubbins." Much can be done to improve grades through pulling at

the right stage of development and the selection of strains that mature ears of uniform size.

Sweet corn is one of the few crops in which there is great competition between New Jersey and Pennsylvania, especially in the eastern part of the state.

The majority of the Pennsylvania crop comes in sacks having about 100 pounds or 10 to 12 dozen ears. The New Jersey crop is marketed mostly in 5/8 bushel hampers, and this as well as other hampers, boxes, and crates of various sizes are used by Pennsylvania growers for packing sweet corn for local market sales.

TOMATOES

Over 60 per cent of the farms reporting vegetable production in the survey, produced tomatoes, and in these reports nine tenths of the growers of canning tomatoes were not included. There is hardly a backyard garden or a farm vegetable garden in the state that does not contain a few tomato plants. The tomato is one of the most common crops on farms where the main business is not trucking, since the crop can be handled with ordinary farm equipment. The sales of canned tomatoes by grocers, being on the average larger than for any other canned vegetable, show a brisk demand for the product during the winter months; while Pennsylvania canning factories put up more cases of tomatoes than any other vegetable. Every county of the state can produce tomatoes though the tenderness of the plant to frost restricts commercial production to some extent in short season sections. There are not many years in which much of an oversupply is produced.

Modern nutrition experts declare the tomato to be one of the finest of vegetables as far as content of vitamines and beneficial mineral salts is concerned. The tomato has its place in practically all diets, as a constituent of many meat and vegetable dishes, as a vegetable served alone, as one of the most wholesome of salads, a thirst quencher, and its juice as a substitute for that of the orange in infant feeding. The healthfulness and palatability of the tomato furnish partial reasons for its popularity. Added to these are the fact that the crop is relatively easy to grow, while the tomatoes are easily and cheaply canned in the homes as well as the canning factories.

Crop Statistics show that Pennsylvania from 1920 to 1923 was harvesting around 6,000 acres of tomatoes, with a yield per acre of 5 to 6 tons. With the increase in 1925 in canning crop acreage and further increases in this direction to come in the next year or two, it is probable that Pennsylvania will move several notches upward in state rank in area devoted to the tomato crop.

Tomato Growing Widely Distributed

If maximum yields of tomatoes are to be expected, a long frost-free period is necessary, warm nights as well as days, warm exposures, and full sunlight. This does not mean however that the crop may not be grown where all these conditions are not provided, since a good local market and other advantages might somewhat overcome climatic difficulties.

There are no clearly defined areas devoted to the production of early tomatoes. Growers try to force the crop to quick maturity since the prices early in the season are usually most favorable. Growers who serve a regular trade throughout the warm months also plant later varieties. In the canning sections of York, Adams, and Franklin counties, the later sorts have been most popular, since they are generally more productive than the earlier ones. In Erie County, however, second early varieties are planted even for canning, although the very earliest kinds, which are considered inferior in quality, are not grown there.

The great majority of commercial men who do not operate special types of soil, plant some tomatoes. However, the market gardeners of Philadelphia County make very small plantings of tomatoes, both because there is strong competition from New Jersey and because the land is expensive and more highly manured than is needed for tomatoes. The tendency in that county is toward the salad and greens crops, with other vegetables on smaller acreages. One needs only to compare the acreage of tomatoes with a salad crop like lettuce, in Philadelphia County, to understand something of the situation. Of 45 market gardeners interviewed, operating 858 acres in vegetables, 38 or 84 per cent, were growing a total of 138.5 acres of lettuce. The tomato growers numbered five, and they planted only 11.5 acres to this crop.

In contrast to these facts from Philadelphia, conditions in the smaller gardening centers stand out very strikingly. For example, 28 market gardeners in Lancaster County reported a total acreage in vegetables of 125.5 acres. Twenty-three growers, or 82 per cent of the whole number, were growing tomatoes, planting a little over 18 acres. On most of these farms the lettuce crop was almost too small to be mentioned. Without doubt the difference in the method of marketing has something to do with the relative popularity of these two crops among the growers. The Philadelphia growers sell very largely at wholesale, and they consequently feel less inducement to plant crops merely for the sake of holding trade. Where personal relations exist between grower and consumer, however, it is often important for the grower to provide a constant supply of vegetables throughout the season, and to endeavor to hold trade for profitable vegetables by occasionally offering less profitable ones.

North of Pittsburgh, and to a less extent reasonably near other cities, farm growers will be found who sell tomatoes only. These men must usually have either a fine market or an exceptional soil and exposure, in order to make money year after year with the one crop.

Early Varieties Most Popular

Climate exerts a large influence on the choice of varieties of so tender a plant as the tomato. It is to be expected, therefore, that the later sorts will be most popular in the warmer parts of the state, the earlier kinds at higher altitudes and in more northerly localities. The competition for the early market tends to favor the early and second early varieties throughout the State, except in the canning country of the southern counties. There is a slightly greater tendency toward the selection of pink and purple sorts in the western half of the state than in the eastern half.

The following figures shows the number of market gardens among those surveyed, as distinguished from truck farms, in which the several varieties were being grown in 1920, and therefore indicates in a general way the popularity of the varieties for purposes other than commercial canning.

Variety	*Farms Reporting*	*Variety*	*Farms Reporting*
Bonny Best	125	Ponderosa	8
Earliana	92	I X L	7
Stone	91	Red Rock	5
John Baer	86	My Maryland	3
Jewel	71	Success	3
Matchless	58	Manyfold	3
Beefsteak	22	Crimson Cushion	2
Beauty	11	Truckers Favorite	2
Greater Baltimore	10	Early Detroit	2
June Pink	10	King of Earlies	2
Globe	9		

The first six of the table may be grouped as the leading varieties of the state. It is significant that four of these are early or second early, while only two, Stone and Matchless, are midseason or late sorts and all six bear red fruit. Except in the canning counties, late varieties like Stone and Matchless are almost always grown beside earlier kinds and serve to prolong the season. Combinations of Bonny Best or Earliana with Stone or Matchless are especially common. Growers sometimes plant several varieties that blossom at slightly different times in order to escape general poor setting of fruit which occurs when long continued rains hinder pollenation.

It it worthy of note that the dwarf varieties, like Dwarf Champion and Dwarf Stone, are rarely found in commercial plantings. Yellow varieties are little planted, only two farms being found where they were produced, although many housewives prefer yellow fruit for tomato preserves. No records were found of the small fruited types

like the pear, plum, cherry, husk, and currant tomatoes. Small plantings of these are occasionally made, as they are sometimes called for by people who like preserved tomatoes. Extremely early varieties as Earliana, are not desired by canners. In York County, the seat of the most numerous tomato canneries, the varieties planted for canning, were as follows, the numbers representing percentages of farms on basis of 100 using these varieties:

Paragon	29%	Red Rock	13%
Stone	20	Bonny Best	8
Greater Baltimore	20	Landreth	5
		Delaware Beauty	5

It is interesting to note that the Paragon, one of the oldest of American tomato varieties, still holds its own in York County. It has probably been somewhat modified by selection. In the canning country some advantage is to be expected from the planting of two or more varieties of different ripening date, in order that the picking season may be extended and loss from too heavy production at one time partly avoided. In the Erie County canning district,, a local strain of Chalk's Early Jewel is favored.

The section of the state where highest yields of canhouse tomatoes were secured in 1924, the new area opened in Franklin County through efforts of the J. H. Heinz Company used a strain of Greater Baltimore. Much of the growers' success in this district may be attributed to the strain used and to the excellent plants grown by the Heinz Company.

The Matchum, a hybrid developed by Dr. C. E. Myers at the Pennsylvania State College, is proving popular as a canning tomato not only because of its yielding quality but from the fact that the foliage is more resistant to disease than many other varieties in common use. Earliness, disease resistance, and high yield, all in the highest degree, have not yet been combined in one strain. Growers must be satisfied at present with reasonable perfection in one of these qualities for each variety or strain.

Various Factors Influence Acreage Per Farm

The average acreage of tomatoes on Pennsylvania farms is small, even in the counties where canning is carried on. Several of the canners plant extensively for their own use, one concern reporting 40 acres of tomatoes on its own property, and another, which handled both sweet corn and tomatoes, operating 250 acres in these two crops, spread over ten farms. However, the acreage on farms not owned by the canners is often but a fraction of an acre per farm.

Among market gardeners and truckers serving retail or wholesale markets, also, the planting on the average farm rarely exceeds one

acre, and is frequently much less. The largest acreage reported by one farm, of those farms that did not supply canneries, was 12. The leading factors that have influenced the farm acreage of tomatoes in Pennsylvania, and which may regulate planting in the future, are as follows:

1. The method of disposing of the crop.

The man who can contract with a canner at a price which seems profitable to both can safely plant a larger acreage than the man who has no such assured market. Many growers feel that wholesale selling in the larger cities is safer, with respect to loss during periods of over-supply, than retail selling during such periods. Whether this is true or not, growers selling through honest commission dealers are perhaps better justified in planting heavily than are those who sell directly to consumers, since commission men are apt to have a better knowledge of general market conditions and can sometimes relieve local pressure by shipping to other cities.

2. Change in prices from year to year.

Growers feel encouraged to plant more or less heavily one year than another because of high or of low prices the previous season. The experience of many years is the safer guide, and it directs that nine times out of ten a fairly uniform planting year after year is the most profitable, unless increased population at home or the development of outside markets provides a greater demand.

3. Labor involved in handling the crop.

Although the planting and cutivation of the tomato does not involve an unusual amount of hand labor, the harvesting of the crop is a tedious operation. Children and women who are successful berry pickers often are not able to handle the heavier tomato containers. This is properly a man's job, and it is safest to limit the planting of midseason varieties at least, to that acreage which can readily be harvested by men and older boys on the place. The labor of harvest has probably had a large influence in fixing the size of plantings in the canning counties. In this state the canning crop must usually be handled by regular farm help, and this rule automatically prevents large plantings. In other states city helpers are sometimes used, but these people are best handled in gangs and they are therefore less useful in a country of small plantings.

4. Competition for labor with other farm crops.

A large planting of tomatoes requires during ripening season constant attention from many persons, and no time can be spared for anything but absolutely necessary farm work. On general farms in Pennsylvania tomato harvest may involve little serious competition with other business. On fruit farms and market garden farms it

is easily possible in growing tomatoes to develop such a heavy labor demand at particular seasons that no one thing can be done well.

5. Effect on the soil.

Sometimes a crop that pays well, considered by itself, leaves the soil impoverished. This is not true of the tomato. Moreover, cover crops can easily be started among the growing plants. For these reasons no one need limit his planting of tomatoes because of the effect of this crop on soil fertility.

Fig. 22. Tomato plants grown for sale in small flats with paper pots.

Fig. 23. Tomato plants grown for sale in small flats without paper pots.

6. Cost of raising the crop.

The tomato crop costs more to produce, even before it is harvested, than common farm crops. This point must be considered when acreage is being determined. The following table shows the costs of production per acre of the canning crop of tomatoes, previous to harvesting, in several sections in 1920.

	Cost Previous To Harvesting	*Total Cost*	*Av. Yield Per A. (T).*
New York, three counties, 107 farms	$105.92	164.22	8.7
Ohio, one county, 26 farms	67.29	100.75	6.4
New Jersey, 205 farms	92.56	135.62	5.7
Lancaster County, Penna., two farms	.....	101.81	6.5

These figures bring out the point that a considerable amount of capital and ready money is required to bring an acre of tomatoes to the time of harvest.

The early crop in market gardens costs much more than the canning crop in Pennsylvania, because of the expense involved in raising or buying the plants, the higher fertilization and the special care commonly given this crop, both in growing and preparing for market. The early crop, therefore, calls for a larger investment than does the canning crop, and for this reason it is not to be planted by those who have too little capital to handle it properly at all stages.

7. Competition from small growers.

Since the tomato is a common crop in the farm vegetable garden, the excess raised by the general farmer and sold in town with other farm products offers serious competition in many sections to the commercial grower of second early or main crops of market tomatoes.

SUCCESSFUL TOMATO CULTURE

The truck crop of tomatoes on general farms usually gets both manure and fertilizer, although in localities where manure is especially plentiful, the crop is often grown with manure alone. Ten to fifteen tons of manure per acre has been found to grow good main crop tomatoes, on land that is in rotation with other farm crops, including corn and clover. The more common practice, however, is to use in addition to the manure from 500 to 1000 pounds of a low grade mixed fertilizer, such as a 2-10-0, 1-8-3, 2-8-2. Smaller amounts of a higher grade fertilizer are preferable. Occasionally growers use only acid phosphate in connection with manure, four or five hundred pounds per acre with 12 or 15 tons of manure apparently making a satisfactory combination. Nitrate of soda as a top dressing is seldom used in this state on the main crop of tomatoes.

The early crop is handled rather more carefully. Here again manure is popular, the crop often being planted on land that has been manured every year for other vegetables, rather than in rotation with general farm crops. Most growers think some manure is necessary for the early tomato crop, although many use less of it than formerly and put this only in the hills or rows before planting. The market gardners use richer mixtures of commercial fertilizers than do the farm truckers, mixtures as 3-8-5 or better being popular. Occasional growers use less nitrogen than this formula calls for, but many at any rate apply 100 pounds or more per acre of nitrate of soda during the first part of the growing season.

One of the best yields of early tomatoes in 1924 was secured in Schuylkill County, with the following method of soil improvement used. Alfalfa plowed down in fall after 10 tons of manure per acre had been applied. 2000 pounds acid phosphate broadcasted in the spring.

Investigators differ as to the need for phosphoric acid and potash in tomato fertilization. It has generally been thought that phosphoric acid is of little help, but at the Pennsylvania Experiment Station it has appeared to be nearly as important as nitrogen. Again, several writers emphasize the need for abundant potash, whereas Pennsylvania experiments on two different soils have shown no benefit from potash fertilization. Perhaps the truth is that when manure is used for tomatoes or for other crops in the rotation little potash is required in the commercial fertilizer.

The tomato wastes, that result either in the canning procedure or in washing out tomato seed are sometimes spread over the land for their fertilizing value, but more frequently are dumped into some convenient stream.

No Systematic Rotations

The acreage of tomatoes on the average Pennsylvania farm being small, no systematic crop rotations including tomatoes have been found. Most growers, given a choice, like to have a sod of some kind to turn under, or a green growth of rye or wheat. Careful growers point out the need of early plowing of sods and heavy growths of green material, in order that decay may proceed as far as possible before the dry period of summer. It is likely that a non-legume sod, plowed early in spring or even the preceding fall, together with a chemical fertilizer fairly rich in soluble nitrogen and with abundant phosphoric acid would best suit the tomato. Occasionally, however, old sods are infested with grubs and cutworms, which make tomato growing difficult.

Growing vs. Buying Plants

Since in Pennsylvania there are no well defined areas where early tomatoes are extensively grown, it is not to be expected that special methods in plant growing should have been developed, such as those used in south Jersey for early tomatoes. The favorite plan among growers of early tomatoes in Pennsylvania is to plant seed in hotbeds or greenhouses in March or April. Many, however, depend wholly upon plants grown by commercial plant growers, who are generally florists, although in the eastern counties several large plant growing establishments have made their appearance. Often commercially grown plants are superior in size and vigor to those that can be grown at home, but it is not always possible to be certain of the quality of the varieties and strains used. Occasionally growers furnish seed of their own growing or buying to plant growers. When there is assurance that the plants delivered have been grown from the seeds supplied, this plan is a good one.

The popularity of commercially grown plants in localities where plant growing specialists have started business is an indication that plant-growing is being recognized as an art and that some growers are glad to shift to other shoulders the burden of plant production. Improvement in the varieties and strains offered by the commercial plant growers and systematizing of their business to the extent that mixing of varieties becomes less common, are two necessary steps toward greater usefulness of this phase of the vegetable business.

In the short season counties of the state even the late varieties of tomatoes are best grown from plants started indoors since late spring frosts delay outdoor seeding. In the southern counties, especially in those where commercial canning is of importance, it has been common practice to use plants from seed sown in the open. This has been thought to result in economy of producing the crop, but the yields from such plants are certain to be much smaller in the average season than from plants started with cold frame protection. The quality of the fruit from the frame grown plants is also likely to be better since a greater proportion of the fruit will ripen before cool weather. The Heinz Company showed in Franklin County during the season of 1924 that the use of good seed and well grown plants is of great advantage to both canner and grower. The Company produced all the plants for the 150 growers in cold frames, built in the spring of 1924. All plants were transplanted. The quality of the fruit produced was high and in spite of an unfavorable tomato season the majority of the growers secured yields of eight tons per acre.

In Philadelphia County tomatoes may sometimes be set out of doors in April. For the larger part of the state the latter part of May is the favorite planting period especially for early tomatoes. In the

northern counties, however, and in sections of the southern counties where tomatoes are canned, the plants are often not set out until June, and an occasional grower even waits until July. June and July plantings are usually made with plants grown from seeds planted out of doors, whereas May planting, except occasionally in the southeastern counties, calls for forced plants. Planting is commonly done by hand though a few growers use two-horse transplanters. With the latter equipment 25,000 plants may be set in a day.

Fig. 24. Combination of strawberries, tomatoes, and onions. A tomato plant is set between every other pair of berry plants and onion sets planted between tomatoes and berries.

Staking and Pruning

Probably the commonest spacing of unstaked tomato plants in Pennsylvania is four by four feet. Popular variations are three and a half by five feet, four by five feet, and four by six feet. Arguments for the wider spacing of the plants in one direction generally have to do with the greater ease of keeping the field clean by cultivation until a later date, the lessened injury during spraying, and often the reduction in injury from trampling of vines during harvest. The spacing will be governed somewhat by the vigor of growth of the variety planted and fertility of the soil.

Some Wilkes-Barre growers report the pollenizing of tomatoes in the field in order to get a good set of fruit on the first cluster. Some have even practiced this in the frames before the tomatoes are moved to the field. The economy of this practice is in doubt.

Staking and pruning of tomatoes are not widely practiced in Pennsylvania. Among those who have grown tomatoes on stakes for commercial purposes there is much difference of opinion as to the profitableness of the plan. Results vary from year to year and from farm to farm. Although many acres of early tomatoes are grown on stakes in the far South, and in the Marietta section of Ohio, Pennsylvania growers have adopted these practices to only a limited extent. The Luzerne County market gardeners are among the prominent advocates of staking and pruning of early tomatoes. These men stake their early as well as their second early varieties. Mr. C. E. Garrahan reports a yield of 30 to 32 fruits from staked plants. In many other sections, staking is restricted to the second early type as Bonny Best. An Altoona grower stakes and prunes all his Ponderosa plants and furnishes his market with a high quality product. Field plants are usually pruned to two main stems, occasionally too but one.

Pays to Prepare Soil Thoroughly

Skilled tomato growers in Pennsylvania have found that time spent in preparing soil properly for the tomato crop is worth many dollars in securing high yields. This crop is characterized by its relative inability to "make its living" under difficulties. It requires a soil well-fined, free from clods and coarse rubbish, fairly deep, and without large amounts of undecayed vegetable matter. On the heavier soils fall plowing is undoubtedly of advantage, particularly when old sods are to be turned under. If animal manure is to be used with the crop, it can be spread on the grass before plowing, or in the case of green manuring crops which are to be turned under for tomatoes in the spring, part of the animal manure may be applied to these in fall or winter, and thus the cover crop itself receives some benefit.

Fields bearing either old sods or heavy growths of rye, wheat, clover, or other cover crops require plowing at least four weeks before tomato plants are set in the open ground. If manure that is not well rotted is to be used, it also should be turned under several weeks before planting time. Deep plowing, provided but little of the subsoil is turned up, is usually of advantage. Subsoiling, or stirring of the subsoil without raising it from its place, though it may be of advantage to the mid-season and late crops, which are sometimes affected by summer droughts, is seldom practiced in this state. The summer cultivation of the tomato crop in Pennsylvania does not differ from that which is given to any cultivated crop of equivalent value, or from the practice followed in other states.

High and Poor Returns

Yields are as variable with tomatoes as with other vegetable crops. The average for the state usually runs from 5 to 6 tons per acre. Two Pennsylvania growers of Penn State Earliana reported a yield in 1924 of 20 tons per acre. The better can-crop yields reported for the same year from Franklin County ran 10 tons per acre of Greater Baltimore. Yields in many sections during that season were low due to the cool moist season.

Insects and Diseases Are Serious

Flea beetles, lice, cutworms, wireworms, slugs, leaf hoppers, the green tomato worm, the fruit worm and the potato beetle, are reported as tomato pests. The tomato plant is susceptible to several diseases, this phase of their culture offering a serious problem to both growers and canners of this vegetable. Blight, leaf spot, wilt, blossom-end rot, and mosaic are well-known troubles through Pennsylvania. The following schedule of control is used by those who successfully check the above insects and diseases:

Bordeaux spray or copper dust in plant beds and in field at intervals of two weeks through the season is used to control blight, and repel flea beetles and leaf hoppers. Arsenate of lead added to the spray or dust takes care of chewing insects that appear, as the tomato worms and potato beetle and to some extent the flea bettle. Lice are killed by a 2 per cent nicotine dust or a nicotine spray, and this will also destroy many of the leaf hoppers. Bordeaux spray is objected to by some growers of the early crop since it delays the ripening of the fruit.

Wireworms that feed upon the fruit that lies on the ground in the fall are controlled only by cultural practices as fall plowing. Cutworms destroy many newly set plants and if numerous, may be taken care of by a poison bran mash. Slugs are troublesome at times but are controlled by scatterings of hydrated lime or wood ashes.

Stalk borers fortunately are not numerous, and though they may be removed with a sharp knife with but slight damage to plants, sanitary measures as burning up tomato plant remains and elimination of weeds are the methods commonly employed.

No control has been found for blossom-end rot which causes worry to many growers. The disease is influenced largely by weather and soil conditions. Frequent cultivation is recommended. Wilt is not common in the state on the outdoor crop and varieties resistant to this disease have been developed. Rogueing diseased plants and rotations aid in control. Sunscald of the fruit is affected by cultural practices to the extent that a sufficient growth of foliage should be provided to partly shelter the fruit from the sun.

Mosaic is apparently becoming more common in Pennsylvania tomato fields. The rogueing of diseased plants, care in pruning and the control of insects such as aphis that spread the disease, aid in checking this trouble.

HARVESTING AND MARKETING TOMATOES

No special method of harvesting has been developed in any part of the state. The tomatoes are gathered by hand and placed in 14, 16 or 20 quart hampers in the eastern part of the state, and in 12 and 14 quart splint baskets in the western part, or in crates or hampers for the canning factory. In most districts where the farmer sells direct to consumer and to the canning factories, the tomatoes are almost, if not quite, red ripe when picked. In the few sections that ship their product a considerable distance, care is taken to pick the fruit before it is ripe or when "turning" so that it can stand the vicissitudes of shipment. Some of the growers for market have their help wipe each tomato as it comes from the field but this practice is by no means universal.

Fig. 25. Wiping tomatoes in preparation for market, one item in cost.

Better Grading Essential

Tomatoes grown in Pennsylvania are generally of good quality but the packing and grading are not as uniform or as well done as much of this crop that is shipped in from New Jersey and other states. More careful grading is needed if any but the very early season crop is to be profitable.

The packages generally used for tomatoes are the 14, 16, and 20 quart hampers east of Harrisburg and the 12 and 14 quart splint

market basket west of Harrisburg. A few growers are using special packages as for instance in Chester County where field tomatoes are frequently packed in the same type basket as used for greenhouse stock.

There is usually a period of oversupply of tomatoes in August and early September in all markets due to the large area over which tomatoes are grown in Pennsylvania, their perishability, and the fact that a surplus crop is produced and marketed from many farm home gardens. Out of town shipments, contracts with canning factories, advertising and cold storage are suggested as means of avoiding glutted conditions.

Pennsylvania growers meet strong competition in the Philadelphia Section from New Jersey, and in the Pittsburgh district and points to which Pittsburgh commission men are accustomed to ship produce, from Marietta, Ohio. Better packing and grading will, in a large measure, help Pennsylvania growers to compete with the outside states. Little competition is provided during the outdoor growing season by other states than the two mentioned as is shown by the carlot unloads on the Philadelphia and Pittsburgh markets in 1923 and 1924.

PHILADELPHIA

State	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	1924	1923
Calif.	2									11	28	13	54	36
Fla.	63	102	174	163	235	20						5	999	1,076
Ga.						12	14						26	—
Impts.	2			9	2	1					2	8	24	99
Md.						1							1	1
Miss.						193	77						270	143
N. C.													—	1
N. J.								10					10	—
Ohio								2					2	—
Tenn.							63						63	2
S. C.						17	32						49	86
Tex.					4	3	1						8	1
Va.							1						1	—
1924	67	102	174	172	241	463	209	12	—	11	30	26	1,507	
1923	64	103	227	270	320	354	34	1	—	6	20	37		1,436

PITTSBURGH

State	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	1924	1923
Calif.										3	5	3	11	30
Fla.	19	39	64	92	82	97	13					3	409	648
Ga.						2	7						9	
Ind.								1					1	
Ky.								1					1	
La.						5							5	
Md.							1						1	1
Miss.						106	24						130	178
N. J.														7
N. Y.									1				1	
Ohio							94	311	13				398	323
S. C.														3
Tenn.							66	2					68	52
Tex.					4	12	42					1	59	49
W. Va.							4	21					25	23
Impts.				5	3	1						2	11	7
Unknown						1	3	1					5	
1924	19	39	64	97	89	224	234	337	14	3	5	9	1,134	
1923	20	39	97	190	250	235	265	192		3	19	11		1,321

MISCELLANEOUS VEGETABLE CROPS

For the purpose of this bulletin the various crops that are not grown generally in large commercial areas and those that are usually considered "Small Crops" have been placed in one group because their relative importance is small and the information on them is limited.

In general the practices used in growing these crops do not differ greatly from those followed in other similar districts of the country. On the whole these vegetables are grown in small amounts on intensively farmed market gardens, where practices remain much the same as far as cultural conditions go, though wide variation occurs chiefly as regards the labor saving devices and methods used on the different farms.

Fig. 26. Use of a vegetable bunch tying machine on an Erie County farm.

As a rule the soil on which these crops are grown is well supplied with organic matter through the use of animal and green manures and is well fertilized by manures and commercial fertilizers. Lime is more generally used than it was a few years ago as its importance in the growing of such crops as spinach, celery, and beets has become better realized. Because many short season crops are grown, following one another in quick succession, it is difficult to get any definite statements regarding fertilization of individual vegetables since the second and third crops during the season get the residual effect of materials supplied to the first crops. Such definite figures as could be secured are given under the comments on the separate crops.

It is with the "Small Crops" also that the greatest number of labor saving implements are used. The multiple-row seeder and multiple-row cultivator are now quite commonly employed in many sections; tyers are almost indispensable where a large acreage of bunch vegetables is operated; electric washers save much labor in the cleaning of root crops, while devices of various sorts have been developed and are used in the preparation and packing of the vegetables for market.

Artichoke

Jerusalem artichokes are not raised on an extensive scale in any part of Pennsylvania but are found in many farm home gardens, particularly in the southern part of the State. The product consequently finds its way to some of the farmers' retail markets such as Lancaster, where the roots are usually sold in small quantities in containers like the quart berry box.

Beans

The snap bean is one of the most important Pennsylvania vegetable crops. According to census figures, the acreage increased from 1645 acres in 1920 to 1800 in 1922, with an increase also in yield from 125 hampers per acre in 1920 to 200 in 1922; and a total production in 1922 of 360,000 hampers.

Delaware, Philadelphia, Erie, and York counties lead in snap bean production. In York County, snap beans are raised for commercial canning. Dry shell beans are raised on only a small scale, a limited acreage in York County, and in large farm gardens throughout the state for sale in farmer's retail markets. Limas are more common in the counties having the longer growing seasons or the warmer soils.

Fig. 27. Combination of strawberries and lima beans. The dead bean stalks and leaves serve as protection and mulch during winter.

A few growers save their own seed but the majority depend on the commercial seedmen for their supply. The Stringless Green Pod, Bountiful, and Refugee are the most popular green pod snap beans of dwarf type for market. Four canneries in Pennsylvania use the Giant Stringless Green Pod to one using Refugee. This speaks well for the quality of the product as Stringless Green pod is usually superior to Refugee. Round Pod Kidney, Pencil Pod Kidney, Wardwell's Wax, and Refugee Wax, are the leading dwarf wax snap beans. The Kentucky Wonder green and wax pods, and Golden Cluster wax are popular pole snap varieties but these are less grown than the dwarf snap beans. The tendency in general is toward the higher quality, though less productive sorts with the green pods popular on some markets, the wax pods on others.

The White Navy and White Marrow types are the best known dry shell varieties but Dwarf Horticultural and Lazy Wife (pole) are grown for sale as both green shell and dry shell beans. Among the limas, Fordhook leads the dwarf types with Burpee's Bush and Henderson's Bush following. King of the Garden, an old and reliable pole lima, still leads Dreer's Improved in popularity. The dwarf limas are more widely grown than the pole types because of shorter season and earlier harvesting except in the Montandon Section where King of the Garden is the main variety used. The demand for lima beans on many of our interior markets is but poorly supplied.

Some growers have practiced starting limas in pots under glass to secure an extra early crop, but this is not a regular custom. Rather it varies with the season and with the greenhouse or frame space available.

Fig. 28. Children taking string beans home from a York County factory. The beans as picked from the plants are delivered at the cannery by farmers, and the officials then distribute these among the neighboring families, where they are freed from tips and threads or strings.

Yields of 150 bushels per acre of snap beans are reported from the canning district of York County. From two to six cents per pound is usually paid for canning beans, the smaller beans bringing the higher price.

Total cost of growing beans for the cannery, exclusive of picking, is reported from a number of farms in New York state as averaging $60.25 per acre.

Bean clippings, the by-product when beans are picked for canning are reported fed to cattle in the green state. Little grading of beans is done in Pennsylvania save for the removal of pods that show disease or are too old. Green shell beans and limas may be marketed in the pod (usually when sold wholesale), or shelled (especially in retail markets). Limas sometimes sell well shelled when they are too old to sell to best advantage in the pod, that is, when the pods have started to turn yellow. They are also easier to shell at this advanced stage than when green.

The packages used for beans vary with the community, but the bushel basket and the hamper are most popular for beans in pod, and the quart or the pint berry boxes are used for shelled limas and green shelled beans. Bushel or half barrel hampers are the common packages for beans shipped from the south.

States that are the main competitors in the fresh bean market with Pennsylvania except for New Jersey are indicated by the following Philadelphia carlot unloads:

State	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	1924	1923
Calif.					1	1	1					1	4	3
Fla.	36	17	10	19	37	8					12	8	147	169
Ga.					1	1							2	5
La.					3								3	1
N. C.					4	58							62	22
Miss.						1							1	3
S. C.					21	16	2						38	69
Tex.				3							3	3	9	
Va.						35				24	16		75	61
1924	36	17	10	22	67	120	3			24	31	12	342	
1923	12	6	9	57	104	51	3			47	29	15		333

Beets

Beets are grown throughout the State in quantities varying from a few rows to several acres. Nowhere are they shipped in carload lots but in every market garden section, particularly in Philadelphia, Luzerne, Bucks and Allegheny Counties, the crop is a popular one. It is one of three crops used largely by farm truckers in the Philadelphia section.

Crosby's Egyptian is well known everywhere as an early beet and as a late variety in some sections. Half Long Bastian is raised in southern Pennsylvania, and Detroit dark Red is favored for canning.

Early Model, Eclipse, Columbia, and Harrisburg Market are also grown. A few gardeners select their own seed.

Extra early beets are raised in cold frames in the Philadelphia section while for the field crop, the plants are sometimes started in frames to gain a week or two on the regular outdoor season. Successions are grown to some extent through the summer months and June seedings are made for fall and winter sales. High grade commercial fertilizers are used and lime is of particular value for the beet crop. Nitrate of soda is often top-dressed to hustle along a backward crop. Sanitation and rotation are used to avoid insects and diseases of the beet crop.

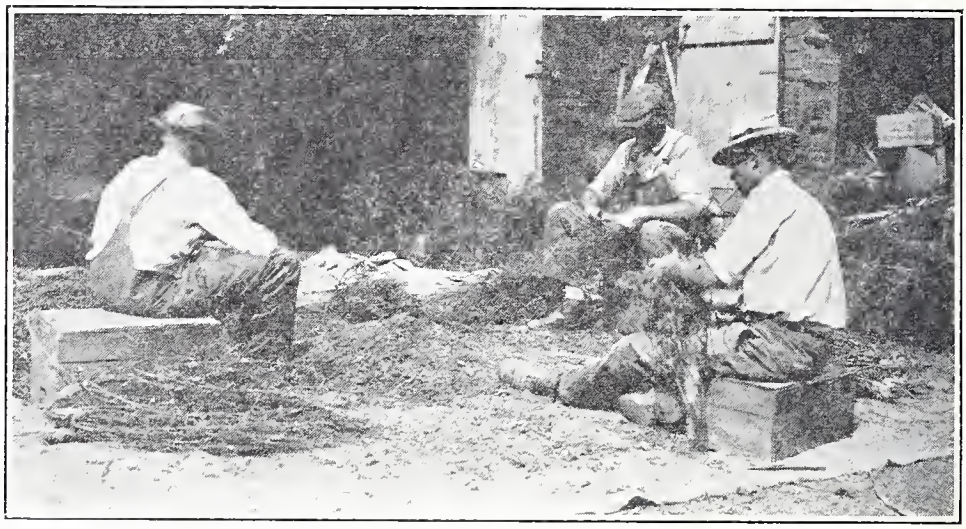


Fig. 29. Thrashing Bassano beet seed by hand, near Bustleton, Philadelphia County.

Most early beets are bunched for market and the majority of the late crop is sold in bulk with tops removed. Field pits are used for storage of beets for all-winter sales. The flat bunch of five or six beets is the most popular type in the southeastern district. Like other root crops, bunched beets are washed thoroughly before marketing. Roots sold in bulk are usually washed if to be sold in small quantities for immediate consumption but unwashed stock which keeps better is used for storage. Little grading is done though most growers bunch together beets of about equal size.

There is no uniformity in the containers used for Pennsylvania-grown beets but growers in other states that ship this vegetable into Pennsylvania have standardized their packages to some extent, with barrels, bushel and half bushel hampers leading for bunched stock; sacks, and round bottom bushel baskets for roots in bulk. The outside growers also pay more attention to grading than Pennsylvania gardeners.

Carlot shipments into Pennsylvania markets as Philadelphia from other states overlap the production of locally grown beets as is indicated by the figures below:

State	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	1924	1923
Fla.	4	6	1	2	1								14	15
La.														1
N. Y.				1									1	—
N. C.					19	13							32	18
S. C.					1								1	6
Tex.	5	4	16	30	19	2						3	79	25
Va.					18	33							51	15
1924	9	10	17	33	58	48						3	178	
1923	1	5	10	21	33	10								80

Brussels Sprouts

The largest area in "Sprouts" reported for Pennsylvania is one acre grown in Chester County in 1924. Smaller plantings are scattered through the state, and though the market demand for the product is good, gardeners here have had trouble maturing a first class crop. Consequently it has been left for more favored sections as Long Island and California to produce Brussels Sprouts for Pennsylvania markets. In this state, as elsewhere, the "Sprouts" are sold in quart boxes packed in 32 quart crates. There are a few exceptions to this package used in retail farmer's markets. The "Sprouts" are not graded as to size carefully enough to put up the best appearance.

Long Island ships "Sprouts" into Philadelphia from November to late February, California from September until March.

Carrots

Carrots are raised in all market garden sections where the soil is suitable, particularly near Philadelphia and Wilkes-Barre, and for carload shipments on the muck soils of Crawford County. They are also forced in frames in Philadelphia County. The demand for carrots has increased steadily in the last few years, and with it the acreage grown in Pennsylvania. On one southeastern Pennsylvania farm 175 acres were seeded to this vegetable in 1924. In Luzerne County nearly every vegetable farmer plants from one to five acres of carrots.

Some of the quick maturing stump-rooted types as Scarlet Horn are used for the extra early crops, but more Danvers is grown for the main crop than all other varieties combined. Oxheart, Chantenay, Coreless and Rubicon follow in popularity. The extremely long types as Long Orange have lost popularity due to damage to the slim tipped roots when harvesting and the fact that they thrive only on

deep light soil. A Bucks County grower reports the hastening of germination of carrot seed and a consequent better stand of plants by burying the seed in bags and sowing after seed has swelled.

In the Philadelphia Section carrots are seeded up to July. They are sown so as to give a stand of carrots about an inch apart in the row. A gardener who plants the largest acreage in that district relates the following experiences:

Variation in strains: "In 1924 a new strain produced 100 bushels per acre more than his old strain because the roots of the former averaged one inch longer than the old sort."

Planting: "Soil is ridged slightly over seed with disc attachment to Planet Jr. drill. Before the carrots come up this ridge is dragged level to destroy the weeds."

Fertilization: "The highest yield in 1924 was secured on ground not fertilized for the carrots, i. e., from the residue of manure and commercial fertilizer applied to the previous crop. On field manured previous to carrot sowing, yield was 100 bushels short of unfertilized field of same area. On the manured field the carrots looked fine, with thrifty tops but small roots."

Yields: "Must be above 400 bushels per acre to pay. My average in 1924 was 500 bushels per acre with some fields yielding 650 bushels per acre."

The early carrots are generally bunched except in the Philadelphia section where most of them are sold in bulk like the late crop. There is no standardization in the size of bunches or the type container used in marketing. Both vary with the locality, and the individual grower. Some of the larger growers grade their carrots according to size and condition.

Competition is shown in the following figures giving carlot shipments of carrots into Philadelphia from other states than Pennsylvania in 1923, and 1924.

State	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	1924	1923
Calif.					1	2						3	6	6
La.					2								2	—
Mass.									1				1	2
Miss.					4	10							14	3
N. J.			1					1					2	2
N. Y.	10		6	11	2	4		4	3	3	3	8	54	46
S. C.					3	1	2						6	3
Texas	3	10	16	16	8	2	2		1			3	61	10
Va.						6							6	1
Wash.			1										1	—
1924	13	10	24	27	20	25	4	5	5	3	3	14	153	
1923	2	6	3	9	11	23	4	2		6	4	3		173

Cauliflower

This crop is grown as an early vegetable mainly in the market gardening sections but as a late crop is produced on a comparatively small scale throughout the State. Cauliflower is difficult to grow in the spring because hot, dry weather is liable to occur at head forming time. One successful grower in the Pittsburgh section states that he never had success with early cauliflower until he exposed his plants so that they frosted severly in the frames. This is contrary to usual practice which provides that the plants shall be protected from extremes of temperature that might check growth. In fact compared with cabbage cauliflower plants are usually "coddled."

Washington, Allegheny, Luzerne and Philadelphia counties lead in cauliflower production. Some of the early crop is started and matured in frames in the Philadelphia district. In the Wilkes-Barre district late cauliflower and late cabbage are raised as general farm crops, with from 5 to 7 acres as the maximum planting.

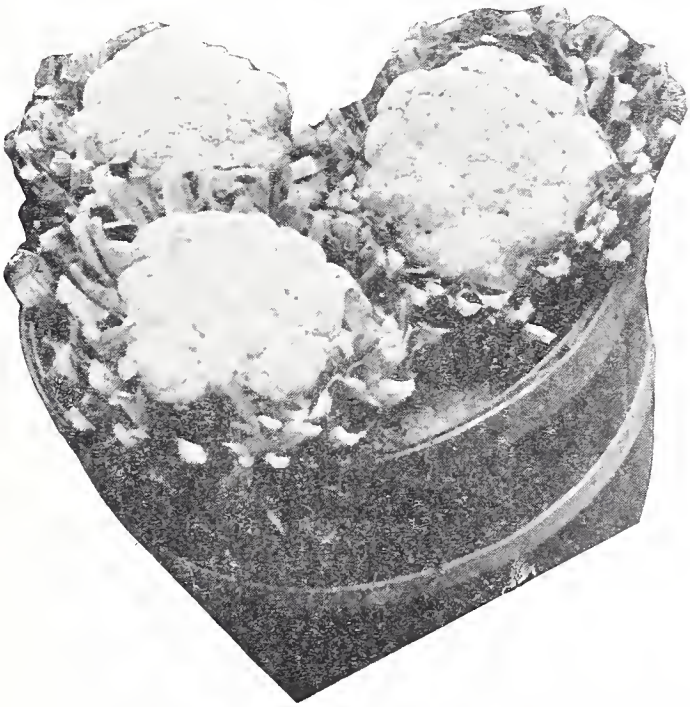


Fig. 30. Home grown Cauliflower as found on the Wilkes-Barre market in September.

The Snowball variety is used by 90 per cent of the growers, with Dry Weather next in importance. The slowly maturing large-headed varieties as Algiers and Autumn Giant are used to a less extent.

Cauliflower is heavily fertilized and most of the growers lime heavily for this vegetable. The Luzerne County farmers often use a

rotation of clover sod-cauliflower or cabbage—potatoes—oats and clover. For the cauliflower and cabbage, excessively heavy applications of manure are used as well as acid phosphate. One grower there secured in 1924, 621 bushels of potatoes per acre, using the rotation above. Only acid phosphate was used on the potatoes.

A common fault of the Pennsylvania farmers who plant small areas in late cauliflower is the failure to blanch the heads properly. Sunburned heads will not compete favorably in the market with those bleached to a creamy white color.

Cauliflower is attacked by the same insects and diseases as cabbage and the same methods of control are in vogue.

No particular package is used in Pennsylvania. The crop is sold by the head on the various farmers' retail markets. A crate of about 12 to 14 heads capacity is popular with Long Island growers. Competition on the Philadelphia market is indicated by the following carlot unload table for the seasons of 1923 and 1924:

State	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	1924	1923
Calif.	31	73	70	16	4	1	------	3	1	------	5	39	243	287
Colo.	------	------	------	------	------	------	------	------	5	1	------	------	6	—
Fla.	------	------	------	2	------	------	------	------	------	------	------	------	2	—
Me.	------	------	------	------	------	------	------	------	------	------	4	------	4	—
N. Y.	2	------	------	------	------	------	------	------	20	112	82	20	236	212
Ore.	------	------	15	12	2	------	------	------	------	------	------	1	30	14
1924	33	73	85	30	6	1	—	3	26	113	91	60	521	------
1923	94	45	64	36	1	1	—	—	6	92	82	92	------	513

Celeriac

Root or knob celery, also known as celeriac is grown on a small scale in Allegheny County and in some market garden sections for local markets. It is particularly liked by peoples of German descent and sale is found for this crop chiefly in sections settled by Pennsylvania Germans. The roots are usually bunched for market like kohl rabi or may be sold in bulk in any suitable container.

Chinese Cabbage

Chinese cabbage or Chinese lettuce is not appreciated as a table vegetable in Pennsylvania, hence has not found popularity with the growers. A few market gardeners near the larger cities raise the crop on a small scale and market it in much the same way as head lettuce. It is produced primarily in the fall since summer heat causes the plants to shoot to seed. However, home gardeners in the Northern counties where the season is cooler than in the southern sections have had success with Chinese cabbage as a spring crop. Two main varieties are used, Petsai and Wong Bok. A leaf spot

disease has been noted in the northern counties. This trouble is spread mainly by aphids and is controlled by eliminating these pests.

Chives

Although this "leaf onion" is found in many Pennsylvania home gardens, it is grown commercially only in a limited way by a few small scale gardeners who sell their produce in farmer's retail markets. The crop is easy of culture and would probably be more popular if better known among the consumers.

Collards

Five acres of Georgia collards, primarily a southern crop were grown by one farmer near Wrightstown, Bucks County in 1923. Due to a change of farm management, the crop was discontinued in 1924 in spite of excellent returns secured by the grower.

Seed was drilled directly in the field and the plants handled in much the same way as cabbage. The entire crop was sold by one commission man on the New York market, where demand for the product came mainly from Southern people living in New York City. The Collards were marketed in crates, three to six stalks weighing around six pounds each, packed to the crate.

Cucumbers

Cucumbers are grown in all sections of the state for pickles and slicing cucumbers. Cambria County probably leads in acreage with Allegheny, Blair, and Erie Counties important sections. Quantities of pickle size are used by the Heinz Company in Pittsburgh but most of these are raised in the Middle West. General farmers in Luzerne County plant a considerable acreage to cucumbers and pickles, fitting them into a rotation of general farm crops.

The most prominent varieties to be used for slicing are Davis Perfect, White Spine, and Long Green. Early Cluster and Boston Pickling are popular pickle types. The crop is often companioned with beans or sweet corn. Seedings in Pennsylvania are made in the field from May 1 to July 1, and a few started under glass in paper pots.

Seed is commonly sowed on the level but in certain sections, cucumbers are planted on elevated hills under which a couple forkfulls of manure have been placed.

Insects and diseases have deterred many farmers from growing cucumbers, the cucumber beetles in particular causing much damage. The squash bug, lice, blight, anthracnose, mosaic, and wilt are also serious troubles. Nicotine and tobacco dusts and Bordeaux spray together with preventive measures help the grower to free his fields from cucumber insects and diseases.

Cucumbers are harvested when of the size desired for market—small or large pickles, slicers, or occasionally yellow ripe cucumbers. Or fields may be picked clean and the cucumbers graded into the various sizes desired, usually one or two for pickles and one or two for slicers.

There are no uniform packages for Pennsylvania grown cucumbers. Competing states use the following: New Jersey and New York, bushel hampers, and the former, the 5/8 bushel hamper; Illinois and Indiana, 12 quart climax basket; Ohio, 12 and 14 quart baskets and 2/3 bushel box.

The main competition in the eastern section supplied through Philadelphia came from the following states in 1923 and 1924:

State	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	1924	1923
Ala.													—	12
Fla.	2			5	90	63				3		1	164	202
Ga.					4	45							49	29
Del.								3					3	8
La.						1							1	—
Mex.					1								1	—
Md.							9	1					10	10
Miss.									1				1	—
N. Y.								3	47	6			56	27
N. C.						76	98						174	178
S. C.						101	5						106	92
Va.							25	3					28	15
1924	2			5	95	286	137	10	48	9		1	593	
1923			10	63	111	223	110		27	8	12	9		573

Dandelion

This greens crop is grown near many of the larger markets where the foreign trade demands it, particularly in Philadelphia County and the coal mining regions. The largest acreage reported on any one farm is 5 acres in Luzerne County. The French variety is most commonly used. A considerable number of frames are devoted to the forcing of an extra early spring crop in the Philadelphia district, the plants having been grown the previous fall and protected over winter. As the season advances the frames are removed. Two to three cuttings are made in the spring and early summer; following which the roots are usually plowed up to prevent the plants from establishing themselves on the farms as weeds. A few growers cut for two years before plowing out. The first crop is ready in the Philadelphia section about the middle of March. For market, the leaves are commonly mowed off and packed like spinach in the packages used on the market where sold. Wilkes-Barre growers soak the dandelion in water before packing to keep the leaves from wilting. The barrel is the most common container for wholesale handling.

Eggplant

Erie County leads in eggplant growing with the remainder of the Pennsylvania crop produced mainly in the southern counties and in such limited market garden sections with warm light soils as are found in Northampton and Lehigh Counties.

Black Beauty holds first place of the varieties grown with New York Improved a poor second. A desirable type for the northern part of the state for farm garden or growing for local markets is the Early Dwarf Purple, which develops early maturing but small fruit.

The crop is handled in much the same way as peppers and tomatoes, though the eggplants are even more tender and can not be set in the open so early in the season. The fruits are harvested when they reach desirable size rather than at a certain stage of maturity. Much the same insects and diseases attack the eggplant as the tomato but flea beetles and lice are particularly partial to the eggplant while wilt is the most serious disease.

In general Pennsylvania growers use any convenient second hand container for eggplants except for the hamper and market box in the Philadelphia section and the splint baskets in the Erie and New Castle regions. New Jersey is practically the only state that competes with Pennsylvania during the season when eggplants may be grown here.

Endive and Escarolle

Endive is grown in all the larger market gardening districts as a summer and fall crop, the Philadelphia, Lancaster, and Wilkes-Barre districts especially favoring this salad. Two types are produced—the Green or White Curled (Endive) and the Broad-leaf (Escarolle). Both may be blanched but the broad leaf type is frequently sold green. The latter is considered to be the superior sort in tenderness and flavor. In Philadelphia and Delaware Counties, seedings are made in March, June, July and August. A Schuylkill County grower sows August 15 in the field, transplants twice, the second time into cold frames, where the crop remains for the Christmas and New Year's markets. A few growers handle the crop in this way but finish the growth in a cool cellar. The heads are packed in much the same way as lettuce though barrels are the most common packages. Small unblanched plants may be tied for market in bunches that about equal in size the single, large heads. Special precautions are observed by the growers in blanching to prevent rotting of the interior of the heads.

Florence Fennel

Florence Fennel, a quick maturing vegetable with a flavor of anise, is seeded in small amounts at any time during the growing season

in Pennsylvania, but does best in the fall in cool weather. The crop is bunched like kohl rabi and is raised by and sold particularly to those of Italian descent.

French Sorrel, Spinach Dock or Sour Grass

This crop is popular in northern New Jersey where quantities are shipped to New York for the French and Jewish trade. The vegetable has found its way to the Philadelphia market and a few gardeners in that section have grown it. Three or four crops are cut per season and marketed in the same way as spinach or kale. Since the plants are allowed to remain in one location for three or four years, the crop may be classed with asparagus and rhubarb as a perennial.

Herbs

Various herbs for seasoning, pickles, and medicinal purposes are raised on a small scale by market gardeners. Of these, the most prominent is thyme, popular in the Philadelphia district, and in Lancaster and Lebanon Counties. Dill, Sage, Mint, Horehound and Coriander are raised to some extent.

What are known as "Potherbs" sold in the Philadelphia market, come from the South Philadelphia market gardens. They are bunches consisting of a cayenne pepper, a leek leaf, and sprigs of parsley and thyme. Five or so bunches are tied into a fan-shaped bundle, and 125 or more bundles packed to a barrel.

Horse Radish

This vegetable is grown both by market gardeners and farm truckers either alone or as a companion crop with early cabbage. Philadelphia County leads in total production for the state. The sets for starting the plant are usually saved by the growers from the side root trimmings of the market roots. The best product is grown on sandy soils though others of heavier texture are planted to horse radish in Pennsylvania. The New Jersey method of lifting and stripping the roots has been little used by Pennsylvania growers.

In the late fall the roots from large scale operations are sold in bulk; while from the smaller plantings they may be carefully trimmed and cleaned, and sold by weight, measure, or bunched, or may be grated by the gardener into vinegar to sell ready for table use. A Northumberland County firm has developed an electric grinder that they use in their stall in the Sunbury market house to grind the horse radish as ordered by their customers and a Blair County gardener has made a motor-operated washer in which the roots are well cleaned with little labor.

Kale

Kale is grown in Pennsylvania chiefly in the Philadelphia section where 15 acres of the crop were reported in 1920. The early crop is seeded there from February 1st to March 1st, the late crop August 1st. Dwarf Curled Scotch is the most popular variety in Philadelphia County but Long Standing is grown to some extent in other districts. The crop is sometimes seeded in rows but is often broadcasted.

Kale is affected by the same troubles as cabbage, especially cabbage worms and lice. The plants are cut in the same way as spinach. Pennsylvania as well as Norfolk Kale is almost invariably marketed in barrels. Norfolk is the only competing section of importance, and ships this vegetable into the Philadelphia market from December to May.

Kohl Rabi

Kohl rabi is not extensively grown commercially but is found in many of the farm gardens, especially among the people of German stock. It is produced chiefly in the spring in the market garden section of Philadelphia, where a limited amount is grown in cold frames and in the field. Kohl rabi can be produced with success in summer or fall. The enlarged stems are harvested with the tops on, bunched in much the same way as early beets or carrots, and marketed in the same containers used locally for other vegetables.

Leek

This vegetable is found mainly in the southern counties, particularly the Philadelphia section. Leeks are sometimes seeded in July and carried over winter, under frame protection, and marketed the following summer, but more commonly are sown from March 1 to April 1 and sold in the late fall. A grower in Bucks County seeds May 1, lifts the plants in the fall, resets them in cold frames, and holds them for the Eastern trade. The variety planted is either White Flag or American Flag. Plenty of moisture and fertility as well as a long season are needed for the leek crop. The stems are blanched toward the base by hilling with earth and the leeks bunched and marketed in the same way as green bunch onions.

Lettuce

Lettuce is produced in considerable quantity throughout Pennsylvania by market gardeners and farm truckers. Philadelphia County led all other sections in 1920 with more than a hundred acres planted to lettuce but the acreage has somewhat decreased since that time. Bucks, Allegheny, and Luzerne Counties follow in importance among

the market garden sections. Only from Tioga County where lettuce is an important muck land crop, is carlot shipping practiced. About 25 cars are shipped annually from Wellsboro Junction in that county. The yield in 1922 was estimated by the Census Bureau at 325 hampers per acre.

Fig. 31. Iceberg lettuce under irrigation, Bustleton, Pennsylvania.

Leaf lettuce, head lettuce, and cos lettuce, the last designated on the market as Romaine, are all grown in Pennsylvania. Philadelphia wants a head lettuce, and the demand for leaf lettuce increases from east to west until Pittsburgh is reached; where head lettuce is again more popular. Leaf lettuce is also extensively grown in the Wilkes-Barre district where the amount planted has increased somewhat in recent years. The larger commercial areas grow head lettuce, but in cities near the western border, as New Castle and Erie, the leaf type is quite popular. The public in general now indicates a preference for a tight, compact head, showing the influence of the wide distribution of California "Iceberg" during the last few years. Romaine is most popular in the heavily populated centers among those of foreign descent.

The earliest lettuce in the spring is matured in frames in the Philadelphia section in March and April but the acreage has been considerably reduced in recent years due to the competition from southern head lettuce at that season. Following the frame lettuce comes the crop started in frames or greenhouses and transplanted to the

field in early spring. In the southern part of the state, a great deal of lettuce is seeded late in the fall (about election day) in frames and carried over winter in the same way as early cabbage. As soon as the ground can be prepared in the spring much lettuce is also seeded directly in the field with successional plantings through the summer until August.

Production falls off in mid-summer due to the difficulty of growing the crop in hot, dry weather, and lessened demand due to the generous supply produced in farm and town home gardens. A few gardeners use frames again in the fall to extend the lettuce season into early winter. Winter demand is met by the greenhouse crop of Pennsylvania and Ohio and the field crop of Pacific coast and southern States.

Gardeners in the Bustleton district of Philadelphia County grow an extra early lettuce crop by preparing the ground in ridges in the fall. The fields in question drain and dry off earlier in the spring than the flat ground and are planted at the earliest possible opportunity in late February or early March to lettuce carried over in frames. The fields are mulched lightly with marsh hay to protect the plants until they get established and the weather moderates somewhat.

Big Boston and Wonderful Leading Varieties.

Big Boston is the most prominent variety grown, particularly as a frame and field spring crop in market gardens and as muck land lettuce. Dutch Butter is also sometimes used as a frame lettuce, and Iceberg is coming into more general use as a second early type. Salamander, and All Seasons are popular for hot weather, while Iceberg, and more recently "Dark Iceberg," also known as Wonderful, New York, or Los Angeles are grown extensively as the late crop. The Wonderful variety averaged two pounds per head for a Montandon grower. Hanson is a semi-heading variety popular in some sections. In Northumberland County it may be seeded broadcast in the spring and sold as leaf lettuce. Grand Rapids is the main leaf lettuce variety grown in Pennsylvania though Simpson and Morse are used to some extent. The last named is said to be particularly resistant to hot weather. Paris White is the chief "Romaine" variety used. Very few growers produce their own lettuce seed.

Overhead irrigation is commonly used for lettuce on the market garden soils, especially for the summer and fall crop. Soils of this type are well supplied with organic matter through heavy manuring and all soils are given generous applications of commercial fertilizer and lime for lettuce growing. The use of nitrate of soda as a top dressing is rather common practice. In the Wilkes-Barre

section manure and acid phosphate are mainly depended upon to mature the early lettuce.

The principal insect troubling field lettuce is the aphis, and this is controlled most effectively with nicotine dust. The cabbage looper sometimes causes considerable damage to the fall crop. For this pest arsenate of lead is applied as a dust or a spray early in the season before the lettuce nears marketable size.

The most serious disease affecting field lettuce is the Sclerotinia Drop. Prevention has been demonstrated in Delaware and Philadelphia counties by the sterilization of frame soil in which plants are grown with formaldehyde solution and the use of uninfected fields.

Little Grading Done.

In the lettuce growing sections around Philadelphia and in Tioga County, the different growers grade their product somewhat as to size and quality but no definite standard is used. Each grower has his own ideas as to what constitutes a good pack. In other sections of the state not so much attention is paid to grading and usually nothing more is done than the removal of small or blemished heads or stalks. The earliest Philadelphia County lettuce is now largely shipped to the mining sections since it cannot usually compete on the Philadelphia market with the more solid Florida stock.

The packages used for Pennsylvania lettuce follow the same geographical distribution that is found in most other crops. The Philadelphia section uses the bushel market box and 14, 16, 20 or 32 quart hampers. One grower in this section uses a special box holding two dozen heads. The use of hampers and second hand packages of every sort extends as far as Susquehanna River. From there on west and especially northwest to Erie, the 12 and 14 quart splint baskets grow increasingly popular. In Pittsburgh itself, however, hampers may again be found in small quantities. Romaine is quite commonly marketed in the barrel in the Philadelphia district. Tioga County uses for lettuce a slatted crate holding two dozen heads as does New York state. California uses a larger crate holding three to five dozen heads while other states shipping into Pennsylvania, use largely bushel hampers and crates. The following figures show carlots received on the Philadelphia market in 1923 and 1924:

State	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	1924	1923
Calif.	67	152	171	186	163	86	4	1	2	34	89	121	1076	785
Colo.									4	6			10	30
Fla.	166	49	28	25	1						2	117	388	553
Ariz.	33	5	1	5	8				2			13	67	55
Ida.										2	20		22	52
Md.													—	1
N. J.	6					1	13	8	5	1	10	2	46	17
N. C.					92	11							103	90
N. Mex.										1	7		8	—
N. Y.							95	148	136	80	2		461	545
Ore.											1		1	8
Penna.							6	3	6	1			16	1
S. C.	1			6	73								80	131
Tex.		5	1		2								8	1
Utah											1		1	—
Va.											13		13	20
Wash.						7	9	2					18	38
1924	273	211	201	222	339	105	127	162	155	125	1[illegible]5	253	2318	
1923	201	226	313	286	206	39	277	195	135	104	131	233		2346

"Romaine" is received chiefly from the Carolinas, New York, New Jersey, and Florida, and the shipping season for this type starts later and closes somewhat earlier than indicated for lettuce in general in the above table.

Melons

There are scattered small acreages of melons in the central and southern part of Pennsylvania but nowhere in this state have these crops progressed in any way comparable to the areas in the western, southwestern, and southern states. Along the west side of the Susquehanna River from Montandon to McKees Half Falls, near Erie, and in upper Bucks County, sandy bottoms are used for these crops in blocks of one half to three acres. A number of general farmers in York County have been raising muskmelons as a side issue for

Fig. 32. Muskmelons grown on a Mifflin County farm.

some time on heavy loam soils while Lebanon, Berks and Lancaster have a few farmers who specialize in watermelons and muskmelons.

Early varieties of melons are preferred since the season is comparatively short, and the melons are usually seeded directly in the field. Only a few growers in the central counties start the melons in pots in the greenhouses.

The varieties that have been most largely used are:

Muskmelons:	Netted Gem
	Emerald Gem
	Hearts of Gold
	Osage
	Tip Top
	Hackensack
	Benders Surprise
Watermelons:	Kleckley's Sweet
	Halbert Honey
	Fordhook

Melons are sometimes planted by Pennsylvania farmers as companion crops with field or sweet corn. In some cases the seed may be sown in missing corn hills, but several growers report seeding in early sweet corn rows right after corn is planted; most of this corn is removed soon after the melons get well started.

For fields of melons only, muskmelon hills are usually spaced 6 x 6 feet and watermelons twice that distance. In several sections, the growers dig holes a foot across and 8 to 9 inches deep, fill these with manure, throw back the soil and seed the melons on the elevated hills thus made. A handful of acid phosphate may also be added to each hill. At Northeast, Erie County, the muskmelons are fertilized by green animal manure under the hills, and a top dressing of 3-8-5.

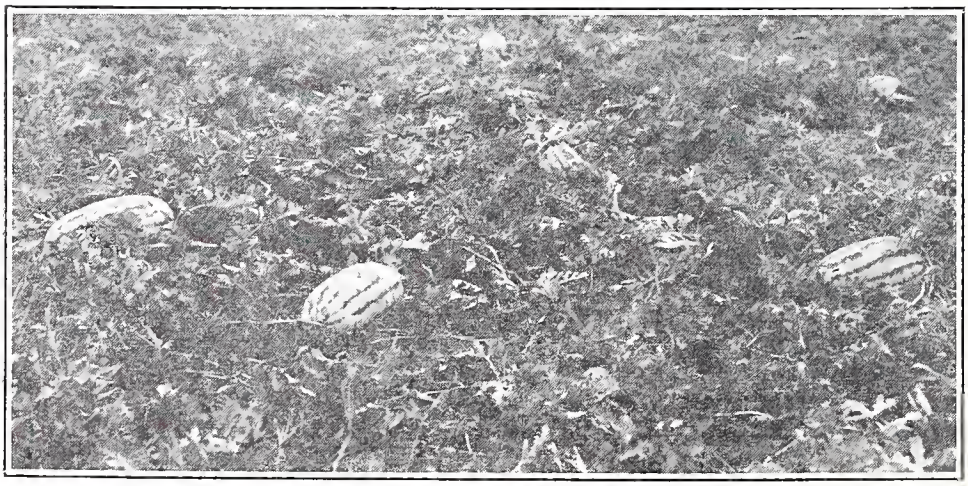


Fig. 33. Watermelons grown on Hoover's Island in the Susquehanna River below Sunbury.

Spraying with Bordeaux is carried out by some farmers to reduce damage from anthracnose and blight. Nicotine dusts are now commonly used for the cucumber beetles and lice though they have not proved entirely effective for the former. Control of these insects helps to prevent wilt and mosaic, diseases that have recently caused a falling off in melon acreage in several counties.

Cost of production records for watermelons in Lancaster County are available for the years 1922 and 1923. These statistics follow:

	1022	1923
Average yield per acre	380 melons	1142 melons
Average cost per acre	$71.11	$110.15
Average cost per melon	.187	.095
Average price paid per melon		.14 to .15
Average number of man hours		380
Average number of horse hours		36

The items of expense in the growing of an acre of watermelons in Lancaster County in 1923 were:

Man Labor	$84.00
Horse	7.20
Rent of Land	2.50
Use of Machinery	1.51
Taxes & Insurance	.88
Cash Expense	4.06
Manure	10.00
Total	$110.15

The demand for home grown melons is so good that the major portion of the crop is sold at the farm.

Watermelons and muskmelons may be sold in bulk from roadside markets. For town markets, the latter are sold in hampers or whatever package happens to be popular in that locality. New Jersey muskmelons are sent to our markets in 20 quart tomato crates or 5/8 bushel hampers, while other states use crates of different sizes.

The table below shows the carloads of watermelons and cantaloupes received in the Philadelphia market in 1923 and 1924:

WATERMELONS

State	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	1924	1923
Del.									68	4			72	40
Ga.						4	365	134					503	214
Fla.						60	156						216	147
Md.								14	52				66	45
N. C.								128					128	225
S. C.							304	181	3				488	299
Va.													—	1
1924						64	825	457	123	4			1473	
1923					8	135	451	323	62					979

CANTALOUPES

State	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	1924	1923
Ark.							10	8					18	—
Calif.					3	348	397	82	43	3	1	1	878	733
Ariz.							100	19					119	62
Colo.									100	89			189	166
Del.								15	2				17	24
Fla.													—	2
Ga.						7	37						44	39
Impts.					10							1	11	2
Md.								42	1				43	78
N. Mex.				4				9	1				14	8
N. J.									1				1	—
N. C.							50	8					58	91
S. C.							5	7					12	11
Tex.					4	1		4	2				11	10
Va.								1					1	—
1924				4	17	356	599	195	150	92	1	2	14 6	
1923					4	306	483	161	181	84	7	—		1226

Okra

Okra or Gumbo, primarily a southern crop is little grown in Pennsylvania save in very small quantities in the southern counties and by one Bucks County firm which has planted several acres, the product to be furnished on contract to the Campbell Soup Company. The crop is seeded directly in the field. The best price is secured when the pods are marketed when small as the quality depreciates with age of pod. The five-eighths hamper is used by New Jersey growers who market Okra in Philadelphia.

Parsley

Parsley is raised in small amounts in the winter in greenhouses, carried over winter to early spring in frames in eastern Pennsylvania, and through the outdoor growing season in all market garden and trucking sections. The crop is comparatively easy to grow, and is little affected by insect pests or diseases. The Double Curled or Moss Curled is the most prominent variety planted. A grower in lower Bucks County reports a gross return from ¼ acre of Parsley of $240. The produce is marketed in bunches of varying size in containers used locally for other vegetables. For shipping either the barrel or the crate is largely used.

Root or Hamburg Parsley is produced to a limited extent in the main market garden sections of the state. Demand comes chiefly from people foreign born or of recent foreign descent especially of the Jewish race. The crop is handled in much the same way as common parsley and the roots are prepared and bunched for market like carrots.

New Jersey is Pennsylvania's chief competitor in summer Parsley with shipping season through June and July for the Philadelphia market; California ships into Philadelphia from December to March and Louisiana from December to May.

Parsnips and Salsify

Parsnips and "oyster plant" are grown to a limited extent in Pennsylvania in all market gardening sections, especially Wilkes-Barre, Philadelphia, and York; and in many farm gardens. The larger areas per farm run from one-half to five acres. Hollow Crown and Guernsey are the most common varieties of parsnip grown though the Short Round French has found some favor for heavy or shallow soils. Sandwich Island is the only salsify variety reported. Both these crops are marketed in bulk, or salsify may be bunched. They may be sold in fall, pitted or dug on mild days for early winter sales, or left in the ground until spring for market at that time. Both these roots are particularly valued for winter and spring when many fresh vegetables are scarce.

The fact that neither parsnips nor salsify are affected by many insects should increase their popularity. Sale is found for the former crop on all markets patronized by people of French descent.

New Jersey is Pennsylvania's main competitor with both crops. The New Jersey product is shipped in 5/8 hampers while the Philadelphia section uses the market box. Very little attempt is made at grading and the roots may be either washed or unwashed.

Peas

Green Peas are grown mainly as an early spring market crop or in limited localities as a commercial cannery crop. In the heavier soils and in cool seasons a few market peas are produced throughout the growing season. Good prices are received for market peas but the labor cost for picking is very high, and difficulty of securing pickers when the peas are in prime condition has limited this crop with many growers.

Luzerne County leads in acreage of early peas with Adams, Columbia, and York Counties with the largest area in peas for canneries. Adams County alone usually has over 500 acres in this crop.

Inoculation of the soil is not commonly practiced but is a factor that should receive more consideration in the growing of the canhouse crop. The Alaska type is the only sort grown for commercial canning since it matures uniformly and the crop may be cleaned up with one or two pickings. Gradus, Nott's Excelsior, Marvel, Blue Bantam, Laxton, and Telephone are popular varieties of high quality for market.

Sugar or edible-podded peas are found mainly in the Lancaster and Berks County sections where the crop is grown from seed saved for years by the Pennsylvania Dutch farmers of those localities.

Peas for canning factories are frequently planted as orchard intercrops or in a general farm rotation involving field or sweet corn

and wheat. One to two pecks of oats or barley per acre are sometimes sown with the peas to keep the pea vines from falling down. Eight to ten tons of manure, and 250 to 300 pounds of a commercial fertilizer as a 2-10-2, a 0-10-5 or straight acid phosphate are used per acre.

Yields of 2 tons per acre of shelled peas are reported in 1924 from Adams County but the more common average is from ¾ to 1 ton per acre. From $60 to $80 per ton is usually paid at the cannery. Cost accounts kept by an Arendtsville vocational boy showed a cost of $48.57 per acre to raise cannery peas. Figures from New York State show total costs per acre of $67.00 to $74.00.

After the peas are removed from the vines, the latter are frequently sold or taken back to the farm for dairy feed, or may be returned to the land and plowed under for soil improvement. There is no record of grading of peas in Pennsylvania. There is no standard package used, though bushel baskets and 5/8 hampers are most employed. Peas are usually sold wholesale by the package but retailed by the pound. The bushel hamper is commonly used by the southern states shipping peas into Pennsylvania.

Competition in market peas is partly indicated by the following table giving various sections furnishing carlot shipments of peas to the Philadelphia market in 1923 and 1924.

State	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	1924	1923
Ariz.				2									2	3
Calif.			2	12	19						1	14	48	30
Fla.	9	2		2							2	2	17	4
Md.								1					1	1
Mexico		3	12	1	5								21	36
Miss.				1	26								27	5
N. C.					74	21							95	103
N. Y.							87	114	17	4			222	145
S. C.					27								27	10
Va.					12	18				3	1		34	18
Tex.													—	2
1924	9	5	14	18	163	39	87	115	17	7	4	16	494	
1923		8	21	32	100	45	130	12		1	1	7		357

Peppers

The largest areas of peppers are found in Erie and Luzerne Counties with scattering plantings elsewhere on warm light soils. The crop is especially popular with that part of the population originating in southern Europe.

The sweet peppers are marketed either green or red, green preferred on most markets, while the pungent types, for which the demand is limited, are usually allowed to reach the red stage. A very few yellow sweet peppers are grown.

Of the varieties, there are more Ruby King peppers grown in Pennsylvania than all other varieties combined. The Chinese Giant is next in importance with Neapolitan, Bull Nose, and Ruby Giant following. The Long Red Cayenne is the principal pungent variety used in this state. The Pimento types are increasing in popularity, such varieties as the Tomato pepper usually bringing a premium in price on many markets.

Two Pennsylvania growers report the saving of their own seed in an attempt to improve their strains. Cultural practice is much the same as for the tomato crop.

Peppers have not been standardized as to grade or package so far. The packages used are the same as for other vegetables in the locality where the peppers are grown. Florida growers ship the crop into this state in 1½ bushel crates while New Jersey growers use bushel hampers and barrels. Carlots received on the Philadelphia market in 1923 and 1924 are shown below.

State	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	1924	1923
Calif.													—	2
Fla.	29	15	8	12	14	49	16				3	8	154	165
Ga.											2		2	1
Mex.													—	1
N. C.							2						2	—
N. J.								3					3	—
Texas												3	3	—
1924	29	15	8	12	14	49	18	3			5	11	164	
1923	14	17	16	22	34	32	5				10	19		169

Poke

Shoots of the pokeweed are found on the farmers' markets of Lancaster and Berks Counties in the spring and early summer. The product is simply cut along the fence rows from the wild product and no attempt is made so far as is reported to cultivate the crop. The shoots are placed on the market loose and sold by the pound, or tied in bunches like asparagus.

Pop Corn

Pop corn is grown generally on a small scale through Pennsylvania for local market supply. The largest planting reported is three acres from Blair County. White Rice is the most popular variety, though a good deal of Golden Queen is also planted. The latter is better in quality than White Rice but does not have such an attractive white color when popped. The product is usually sold on the ear in any container used locally for other vegetables.

Radish

Philadelphia, Luzerne, and Northumberland Counties lead in the production of radishes, vegetable farms there having from a fraction of an acre to seven acres in the crop. Radishes are grown from February first to November first, with frames used to extend the season both spring and fall.

The Scarlet Button types are preferred both very early and very late, with the White Icicle popular on markets that desire a long white radish. The White Box is popular in the Philadelphia section where it was developed and Scarlet Turnip White Tip is found on some markets. In summer, larger types as Crimson Globe, Chartier, Lady Finger, and Strassburg are used. Some of the large winter radishes are produced in the late fall, the White Chinese ranking first over Chinese Rose and Black Spanish.

Since radish seed is easily grown and saved, several growers have developed a more uniform product through selecting and saving their own seed.

Lice and cabbage maggots are the most troublesome pests. The Montandon section reports that lice cause most injury to summer radishes, with less infestation on those grown late in the fall, and none on the early varieties. Nicotine dusts control the lice while for cabbage maggot the radishes are treated with corossive sublimate when the first true leaves form and at intervals of ten days thereafter.

All the small and medium size radishes are bunched for market, the size of the bunches and the container used varying with different markets. Grading is carried out by some growers to the extent of placing radishes of the same size in the same bunch. The large winter radishes are usually sold in bulk, the same as late turnips and late carrots. The chief competition from other sections is furnished in the early spring by Norfolk, South Carolina, Mississippi and New Jersey.

Rhubarb

Rhubarb is one vegetable in which Pennsylvania furnishes almost her entire supply. It is especially popular with market gardeners, many of whom plant it on their heavier soils. There is little of this crop shipped in from other states except small amounts to Philadelphia and Pittsburgh. Philadelphia County leads the state with more than 100 acres in rhubarb. The largest single planting reported is about 40 acres. Delaware County grows much rhubarb and the crop is very generally produced by York County gardeners, though on smaller areas. Rhubarb is primarily an early spring crop so that the amount offered on the markets decreases as the warmer season advances.

A certain amount of the crop is dug in the fall for forcing during the winter and early spring months. (See Department Bulletin No. 396) but ordinarily rhubarb takes its place alongside asparagus as a field crop. There are many strains of this vegetable grown and commercial varieties are not at all true to type. In general, medium to large size stalks with deep pink color are most desired. The popularity of deep color is signified by the reporting by many growers of the use of the "Strawberry" variety. The crop is heavily fertilized by those growers who strive for an extra early crop.

Fig. 34. A Rhubarb field at Bustleton, Pa.

Gardeners have had considerable trouble with a crown rot disease of rhubarb which has caused heavy loss of roots in producing fields. In starting a new field, it is recommended that a grower secure roots from disease-free stock and plant them in ground which has not been in rhubarb for some years past. Disinfection of new roots with corrosive sublimate (1-1000) if infection is suspected, early planting, and heavy fertilization are desirable.

The only report of yield secured was 10,000 bunches per acre in 1920 by a Delaware County grower.

There is no uniformity in the size of bunches put up by the different growers and the rhubarb is generally sold without any container. Bunches tied in two places with red tape show off most attractively. One Pennsylvania grower places 3 to 4 stalks in a

bunch, ties a dozen bunches in a bundle, and wraps each bundle in heavy paper. Boxes of about one bushel capacity are generally used when rhubarb is shipped.

Spinach

Spinach is the main "greens" vegetable grown as a spring and fall crop in all gardening sections of Pennsylvania and has been increasing greatly in both demand and acreage planted. In the southern part of the State seedings are made in August for the fall and early winter market, occasionally in mid-September to hold over winter under a mulch for the extra early spring crop, and again from February to May or later for development in the spring and summer. The early spring crop known as "hard ground spinach" is frequently broadcasted on fall prepared ground on mild days in February. Around 200 acres are generally produced in the Philadelphia section and large areas near Pittsburgh and Wilkes-Barre.

The growers prefer a late spring variety that does not "shoot to seed" quickly during the brief hot spells that come in May and June and therefore use extensively King of Denmark, Long Season, and New Summer. For hard ground spinach, for the fall crop, and that carried over winter, the Bloomsdale Savoy type is grown. The best strain now used is the Virginia Savoy since it is resistant to "blight" or "yellows," a disease that has been quite serious in late spinach in this state. This type is not satisfactory however as a late spring spinach, since it bolts to seed rather quickly with the advent of hot days. A new variety of the same type is being developed in which this difficulty may be overcome.

The New Zealand Spinach, a different sort of plant, that thrives in hot weather, is gradually increasing in importance for growing in summer. This type holds up well on the market, is easy to clean, and can be grown at a season when other spinach does not thrive, so should appeal to dealer, consumer, and grower.

Spinach seems to thrive on a variety of soils. Many growers favor a sandy type and yet the Philadelphia Section crop is produced on clay loam soil. Spinach needs plently of moisture, especially during seed germination and early growth of the plant. Heavy fertilization is needed and the crop does well only on limed soils.

Possible yields of spinach in Pennsylvania are indicated by the report of a Philadelphia County gardener who produced 986 bushel boxes of this crop on nine-tenths of an acre in 1924. In this case, 1500 pounds of a 7-6-5 fertilizer were broadcasted over the field before the spinach was sown. The seed was also broadcasted and the crop cut the latter part of September.

Lice sometimes cause trouble but may be controlled by nicotine dusts. "Yellows" on the late crop is largely eliminated through the use of the Virginia Savoy variety. The crop is marketed in containers used for other local vegetables but the round bottom bushel basket, the half bushel or bushel hamper, and the splint basket, seem most largely and satisfactorily used.

Carlot shipments of spinach into Philadelphia in 1923 and 1924 are shown below:

State	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	1924	1923
Calif.													—	12
La.													—	5
Md.													—	1
N. C.				3									3	2
N. J.	2								1	2	1	4	10	27
N. Y.							2	2	1				5	1
S. C.			6	4									10	60
Texas	16	53	91	37								8	205	104
Va.	43	3	8	151	53				1	1	10	58	328	335
1924	61	56	105	195	53		2	2	3	3	11	70	561	
1923	74	57	145	162	29					22	18	40		547

Squash and Pumpkin

These are common vegetable crops in Pennsylvania, the early types of squash being raised quite generally by market gardeners, and the late squashes and pumpkins by truckers and general farmers. Distribution is more concentrated in the southern counties where the season is longer. The largest area reported by any one farmer in 1920 was 5 acres in Berks County. By general farmers the crops are largely planted in the missing hills in corn fields and the squashes or pumpkins follow the corn in maturity. In Columbia County a small amount of these crops is raised for the cannery.

The most popular varieties of early squash are the White Bush Scallop and the Summer Crookneck. The Cocozelle or Italian Marrow is liked by some growers and on a few markets. For late squash the Hubbards and the Boston Marrow are probably most largely grown. For discriminating markets, the fine quality Winter Luxury and Small Sugar Pumpkins are raised, while the larger types as Big Tom and Connecticut Field are popular in corn field planting.

Insects and diseases are much the same as attack cucumbers and melons, with the squash bugs, cucumber beetles, lice, and vine borers most destructive. Except for wilt, diseases are usually less serious than with the other cucurbitous crops.

Early squash is harvested for market while the rind is still tender; with late types more advanced maturity is necessary so

that they keep well. The crop is stored in Pennsylvania only on a small scale since proper storage facilities are seldom available on the average farm.

There is no record of these vegetables being graded in Pennsylvania. They are usually sold loose in bulk though some growers use barrels of various sizes for the winter varieties and baskets and hampers for the summer squash. These same packages are used by the out-of-state growers who ship to Pennsylvania markets, including those who ship to Philadelphia, pumpkins from New Jersey in late fall and early winter, and squashes from South Carolina (May and June), North Carolina (June), New Jersey (June to September), and Florida (November to May).

Sweet Potatoes

Sweet potatoes are grown for market chiefly in the vicinity of Montandon on warm, sandy soil along the Susquehanna, and in upper Bucks County on similar soil of the Delaware River bottoms. Sunbury furnishes a market for the Montandon sweet potatoes and Easton for those grown in upper Bucks. Through the southern tier of counties, this crop is produced on a small scale for local markets such as Lancaster. In Northumberland County, the Yellow Jersey type is used while the Red Jersey variety is grown in Bucks County. The seed is secured mostly from New Jersey though there has been a spasmodic effort on the part of Pennsylvania growers to select their own seed. All the gardeners grow their own "slips."

Sweet potatoes in Pennsylvania are commonly planted in ridges and fertilized by animal manures and commercial fertilizer.

The potatoes are marketed usually in one-half bushel hampers, or by weight or measure without any container on the farmers retail markets. Growers in the Montandon Section secure a premium in price for their locally grown "Sweets" over those shipped in from New Jersey and the South.

Yields have been running under two hundred bushels per acre, but with the recent use of improved seed, it has been demonstrated that considerably better crops can be produced. A Northumberland County farmer in 1924 demonstrated that he could secure an increase in yield of 75 bushels per acre due alone to the use of high grade seed.

Swiss Chard

There are only a few records of Swiss Chard being grown commercially in Pennsylvania. In fact it is little grown for market anywhere since the crop is well known to home gardeners, is easily

grown, and a few feet in the garden will keep a good sized family supplied with chard all summer. The use of chard as a summer greens in hotels and restaurants has not assumed importance enough to bring to the vegetable growers much demand for this crop.

Turnips and Rutabagas

Turnips are grown generally through Pennsylvania but not on an extensive scale. Carlot shipments are reported from some of the northern counties but these are irregular, being the combined output of many farmers which has been gathered by produce dealers. York and Philadelphia sections lead in acreage devoted to turnips. The major part of the crop is sown in late summer for sale in bulk during the fall and winter. It is common practice among farmers to seed turnips broadcast through the corn field. One farmer in Cumberland County seeds annually ten acres to turnips in this way, following the last cultivation of the corn. The early turnips are generally grown in rows and may be bunched for market by the commercial vegetable producer or sold in bulk as is the practice with the Philadelphia Section crop. The White and the Purple Top Milan, flat turnips are the main spring bunching varieties. Purple Top Globe is the most popular for late seeding. On most markets, the white-fleshed turnip is preferred though the Yellow-fleshed type has a better flavor.

Rutabagas are grown to a greater extent than turnips in Philadelphia County but on a generally smaller scale than turnips through the rest of the state. The crop requires a longer season than turnips but is valued for the fine flavor of the roots. Seed is sown in rows the same way as turnips and in the farm garden at thinning time, the excess plants are successfully transplanted. Golden Neckless is the main variety grown.

Growers have considerable trouble from plant lice especially with the fall crop when warm, dry weather favors this insect. Spraying was not effective because of the impossibility of covering the undersides of the leaves where the lice feed; and before the introduction of nicotine dusts, the production of turnips and rutabagas had been abandoned by many growers. Cabbage maggot is sometimes serious but may be controlled in the same way as for radishes. Club root and other diseases of the cabbage family are generally prevented by rotation.

The Philadelphia market prefers a medium sized turnip. One grower there has taken advantage of this fact by making two grades, No. 1 grade containing all sound turnips of about 2½ inches in diameter, and No. 2 containing roots larger and smaller than the first grade. The No. 1 grade is also washed and packed in 5/8

bushel hampers, and makes an attractive package. The market box, barrel, and 100-pound sack are other containers used. Much of the Philadelphia crop is shipped to the coal regions of the state.

An average annual yield of late turnips over a period of several seasons of 200 bushels per acre is reported from Delaware County.

Competition in turnips on the Philadelphia market is furnished mainly by New Jersey from late June until the following April; in rutabagas by New Jersey during almost the same season as turnips and by Canada and New York from late November until April.

Water Cress

Since this crop requires special conditions of moisture, it is grown only by a few farmers who have shallow ponds or streams suited to its culture. Water cress finds ready sale on the large markets for salads and garnishing. It is sold in bunches of various sizes, loose in bulk, or may be placed in quart boxes packed in 32 quart crates.

Witloof Chicory or French Endive

Witloof chicory is a forcing crop, but the roots from which the creamy white salad heads are developed, are grown in the field in much the same way as parsnips. This crop is discussed in "Vegetable Forcing," Department of Agriculture, Bulletin 396.

OUTSTANDING NEEDS OF VEGETABLE GROWING

The contact between vegetable growers and representatives conducting the survey has brought to light and emphasized a few outstanding needs of the vegetable growing industry of Pennsylvania. Among the more important of these are:

1. Better understanding and more cooperation between market gardeners and commercial truckers on the one hand and farm truckers on the other. In some parts of the state, a strong feeling exists on the part of the commercial grower against the farmer who grows only a few vegetables as a side line. The latter frequently considers the surplus vegetable products of his farm as costing little, since the labor is furnished largely by the farm helpers, and consequently a small selling price may be asked which sometimes results in a break in prices. If the commercial grower establishes and maintains a reputation for careful grading and high quality, he should be able to withstand periods of glut and lowered prices. Consumers are coming to demand the best grade products and will be willing to pay for them. As the farmer gets better acquainted with the high cost of raising a vegetable crop, he will be less willing to sell at low figures. The linking of the commercial

grower and the vegetable side-line farmer through the several county organizations is a way to better understanding of all problems.

2. More cooperation between commercial growers themselves is needed. When growers have been brought together through farm associations they have been able to work out problems both of community nature and relating to their own businesses—and at the same time have developed the social and educational life as well as the friendly spirit so needed among the growers.

3. Labor-saving devices and methods are needed on many market garden farms. Some operators do not take advantage of knowledge and equipment now available but a greater study of this subject is needed in order that the labor cost of vegetable production may be cut to a minimum.

4. For the sake of greater economy in vegetable production, a state wide investigation of the true functions of stable manure and its substitutes in the growing of vegetables should be carried out. The manure shortage is making itself felt chiefly in the more highly developed gardening sections but may be of genuine concern to nearly all growers in the future.

5. Grading methods and practices need attention, both from the growers standpoint and for the sake of the consumer's interests. The Pennsylvania Bureau of Markets is making special efforts to study grades and is in a position to render invaluable assistance to growers in this regard.

6. Nearly every vegetable grower can tell of unfortunate experiences with inferior seed. When the growers come to feel that only the best seed will do and will buy accordingly, the commercial seedsmen will meet the demand to procure such seed. Nevertheless there is evidence that the field will be open to the home seed grower who uses proper breeding and selection methods, and to the organization of growers that deals directly with a reputable seed grower.

7. The use of varieties of high quality is of special importance in order that home grown vegetables may be favored over the products shipped in from other states, the latter frequently being selected for enduring the vicissitudes of transportation rather than for flavor and quality.

8. For the sake of regulating the supply of vegetables on both small and large markets, more attention to both temporary storage during warm weather and to storage for longer periods in the fall and winter should prove profitable. This matter is one that demands scientific investigation since our present knowledge of storage methods is suprisingly meagre.

9. Modern methods and equipment for the control of insects and diseases and knowledge of how to use them are needed on many vegetable farms if reasonable returns are to be expected.

10. Both the canning companies and the growers who produce vegetables for the canning industry will benefit through the more extensive development and use of vegetable strains that yield well and have desirable canning qualities.

11. In the growing of tomatoes for the canning factory, the use of well grown plants started in the hotbed or greenhouse and transplanted to cold frames should replace field sown plants, while community plants beds are also to be recommended.